

/ THE DIVISIONAL COMBAT ENGINEERS AND THE DEVELOPMENT
OF MECHANIZED WARFARE
1918 - 1942 /

by

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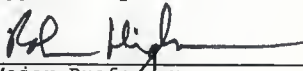
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DEFINITION OF TERMS

Modern Warfare -- combat operations after the introduction of mechanization to the battlefield.

Strategy -- the management and maneuvering of forces up to the point of contact with the enemy.

Tactics -- those methods and techniques of employing forces when in contact with the enemy.

Counter-Mobility -- to impede the enemy by reinforcing the terrain through the use of obstacles which utilize and improve on existing obstructions and natural barriers. Obstacles normally are emplaced in belts or systems which are covered by direct fire weapons to make them more effective.

Mobility -- to reduce the efforts of existing or reinforced obstacles so as to improve or make possible the maneuverability of tactical units and allow for the forward movement of essential logistics.

Hasty Operations -- require imagination and ingenuity in the use of available resources, and are normally conducted under enemy fire when speed is extremely important. In the advance, the combat engineers should be located with the lead elements of the maneuvering units so as to be best employed for maintaining momentum of the attack by reducing the effects of obstructions to maneuver, and mobility. Engineers also can increase flank protection by creating hasty obstacles on avenues of enemy approach to the flanks. In the defence or in blocking operations, their location is situation dependent. Field fortification and counter-mobility obstacles are accomplished when in contact or about to make contact with the enemy, and normally should consist of fox holes, open weapon emplacements, and simple obstacles as the situation permits, to increase the strength of the position and to reduce the mobility, maneuverability, and offensive advantage of the approaching enemy.

Deliberate Operations -- differ from hasty ones in that they are more permanent in nature and are accomplished when enemy interference during preparation is unlikely. In addition, sufficient time exists for thorough reconnaissance and careful preparation. In this case, combat engineers can be located to the rear and called forward to accomplish missions. Field fortifications consist of elaborate trenchworks, covered emplacements, and obstacles as the situation requires.

PREFACE

Through my experiences as an engineer officer in the United States Army, I quickly learned that one of the greatest problems during operations on the modern battlefield lay in the cooperation between arms. This was especially so in the case of the divisional engineer who, as a participant in various field exercises, tended to follow the major combat arms across the maneuver area with no real purpose. The relative capabilities of the combat engineer were left untapped by maneuver force commanders who showed very little appreciation or interest in how these aspects could enhance the combat potential of their units. This thesis is intended to help in the resolution of this deficiency by emphasizing the incorporation of the combat engineer in battlefield operations as an essential aspect of mechanized warfare.

The theme of this paper is to show historically how and why the role of the divisional engineer, through the development of mechanized warfare, evolved from an indirect support function to one of major influence over battlefield operations. This transition was contingent on the emancipation of military doctrine and planning from the constraints of traditional military elitist attitudes which, in turn, allowed for the development of the mechanized formation as a strategic weapon. Through the realization of combined-arms operations, the armored division, as an independent striking force, revolutionized warfare. The dynamics of this formation greatly depended on the mobility and counter-mobility potential of the combat engineer.

Prior to and in the first three years of World War II, the

effectiveness of armored formations differed significantly between the Allied and Axis countries. This was due, primarily, to the degree of combined-arms organization and indoctrination reached and the role played in it by the combat engineer. In the Allied nations, the conservative military elites feared the infringement of mechanization on their traditional, chivalric concepts of warfare and, consequently, established armored formations as tactical aids to infantry and cavalry based combat operations. The combat engineer remained an indirect support arm, mainly concerned with deliberate and static construction. This situation persisted despite the theories of Martel, Fuller, and Liddell Hart who, with foresight, proposed the development of mechanized formations as the basis of future warfare.

The Axis nations, in contrast, had realized these concepts almost perfectly by the end of the 1930's. The corporate spirit and aggressive nationalism induced by Fascism had lifted the conceptual constraints experienced in the Allied nations and allowed for the development of the armored formation as an offensive strategic weapon. Through the application of combined-arms principles, rapid maneuverability was reintroduced to combat operations. Thus, the combat engineer, as the proponent of mobility and counter-mobility, provided greatly for the dynamics basic to mechanized warfare.

The conflict in North Africa provides a vivid comparison of the opposing concepts for the employment of mechanized forces. During these campaigns, two main trends emerged. First, the decisiveness of the proper employment of the combat engineer as

part of the mechanized combined-arms team to success on the dynamic battlefield and, second, the superiority of the strategic use of armored formations over their tactical use. Throughout most of the campaigns on the Western Desert, the Allied forces adhered to the traditional concepts of warfare and, as a result, were consistently defeated by the dynamic combined-arms team of the Axis forces. Through a slow process of trial and error, the Allies eventually adopted the methods of their opponents. The final decision at El Alamein was significantly dependent on the Allied assimilation of the combined-arms principles and the proper employment of the combat engineer into an armored dominated battlefield.

This thesis will show that the success on the mechanized battlefield depends, above all else, on the application of combined-arms operations and on the mobility and counter-mobility potential of the combat engineer, who provides the dynamics on which modern warfare is based.

CHAPTER I

Before mechanized warfare, the combat engineers in European armies were inhibited from exercising their full potential in assisting combat operations, on both the tactical and strategical levels, due the conservative attitudes of their aristocratic leadership. During this period, cooperation of arms was actively avoided. Later, with the advent of mechanization, the deep-rootedness of this relationship retarded the incorporation of the technical arms, paramount to armored warfare, into combat operations.

INTRODUCTION¹

Towards the end of the Middle Ages, the military engineer can first be identified playing a part in army field operations, as distinct from doing construction. This resulted primarily from the evolution of warfare itself, as feudalism gave way to the technological and social changes of the Renaissance and Reformation. With the increased independence of the towns and cities with their middle classes, and the introduction of fortifications and armed foot soldiers for defense of such urban centers, the old feudal armies, controlled primarily by armored horsemen, could no longer dominate warfare. Furthermore, through the development first of the bow and arrow and later of artillery and muskets the infantry became a viable force on the battlefield, especially against heavy cavalry, since it could fight effectively at a distance. It is during this transition then, as armies began to be organized more around the infantry

arm instead of the cavalry, that the military engineer was first able to influence combat operations.

In their early employment during the 16th and 17th century, the military engineers were used in conjunction with artillery during sieges of fortified towns and fortresses. They had no real organization or permanency as a distinct body. Normally, a professional engineer would be contracted to supervise any work required of a group of civilian laborers during the course of a campaign. These personnel, called sappers and miners, were primarily committed to the construction and excavation of cover and concealment in support of besieging operations. While the sappers constructed reinforced breastworks for artillery, and trenches for assault forces in order to breach the fortifications from above, the miners excavated subterranean galleries to provide for passage of attacking forces under the walls. Together with the artillery arm, the military engineers consisted of artisans and commoners, led by specialists of the bourgeoisie. At the conclusion of hostilities, as with the rest of the army, these organizations disbanded until the next Call to Arms.

During the Religious Wars of the 16th and 17th centuries, the "Feudal Knight" of the nobility, looked on in resentment as the infantry, assisted by the artillery and military engineers, gained superiority over the cavalry on the battlefield. Even though the nobility had to give way to the progress of warfare, they did not accept the infantry, artillery nor military engineering as honorable arms. Instead, they considered these new military skills the product of the urban arts and crafts of the

rising city bourgeoisie, an example of the very economic, social, and intellectual changes which were disintegrating their feudalistic way of life. Towards the infantry, however, this attitude would be greatly amended when, by the early 18th century the nobility as military entrepreneurs, had easily assimilated this arm by recruiting regiments for hire from their own hereditary lands. But, to have attempted this for the technically oriented arms of artillery and military engineering would have been too expensive and uncomfortably scientific for the otherwise romantic mentality of the nobleman. Consequently, these arms remained under the leadership of the bourgeoisie, and the contempt of the nobility for them became part of a heritage which persisted from its feudal origins into modern warfare, so much so that noblemen who later commanded national armies never were able to become fully accustomed to their proper use.

As armies grew in size, and success on the battlefield increasingly depended on training and drill, standing armies appeared which enabled the sovereigns of emerging nation states to centralize power and control by suppressing the private armies of rival lords and providing protection and stability for the economic aspirations of the ascendant urban bourgeoisie. By the mid-18th century a new political system in the form of the dynastic state had been firmly established. The middle class, in exchange for an economic milieu of perpetual prosperity, was quite willing to concede the management of the nation and army in favor of the sovereign, thus allowing them to devote their full energies to commercial enterprise and profit. This condition greatly benefited the nobility, who moved in to officer the

expanding standing armies, since the demise of the feudal system left them with no other livelihood enabling them to maintain, to a great degree, their traditional influence and social position. This entrenchment of the nobility in the leadership of the army brought the military forces as well as the state under control of the sovereign, for the fate of those in the officer corps depended, above all else, on the prince.

For the military engineering arm this meant that its leadership would continue to be fixed in the bourgeoisie and, thus, in its formal beginnings, it existed as a somewhat neglected service. Moreover, throughout the evolution of the dynastic state the developing state bureaucracies were almost completely based in the progressive and financially powerful urban centers. Accordingly, from their origins, they stood under the domination of the bourgeoisie, since law, engineering, and finance suited the mentality and interests of the keen-witted businessman better than the land-owner. This administrative encroachment by the bourgeoisie, in turn, was accepted with indignation by the nobility who soon grew apprehensive of any new developments in technology or in the science of warfare, which they viewed as mainly the products of the progressive and competitive spirit of their inordinately rationalistic rivals. Since social position rather than intelligence served as the criterion to gain an officer's commission and rank within the army, the noble officer shunned technical education and any continued theoretical military training, relying instead on experience in combat. Consequently , military engineering was

unwisely viewed as a menacing yet unavoidable aberration and, thus, up until the end of the 18th century generally no permanent establishments of combat engineers in standing armies existed.

For the War of the Spanish Succession, however, units were recruited and, for the first time, the officers and men of combat engineer units were uniformed and held military rank. During most of the dynastic wars of the 18th century formations of military engineers can be identified in support of field operations. These company or battalion size units of pioneers, sappers, miners and pontoniers normally were commanded by military engineer officers, but, frequently also by officers of other arms on a temporary or mission basis. Since these units did not have a parent engineer organization. They were in most cases either attached to or actually formed as part of the artillery, with their primary function being to support this arm during sieges or on the battlefield.

The duties of the sapper and the miner had changed very little, however, the techniques of siege warfare had become far more effective. A siege process generally started with a trench dug parallel to the fortifications under attack which, under the protection of the infantry, was progressively widened and deepened until it formed a covered road. This excavation, called a "parallel", was actually an avenue, along which artillery, transport, and personnel could move sheltered from the detection and direct fire of the besieged. Next, batteries of guns and mortars would be installed to gain superiority of fire, and to silence the enemy guns on the section of the fortification to be

assaulted. This process continued at 500 meter intervals until the attacking forces were close enough for their heavy artillery to batter a breach into the ramparts. If necessary a covered road was dug through the breach itself, thus allowing assault troops to enter the fortress. Throughout the sapping operation the miner listened to detect any of the enemy's miners, who normally tried to construct underground passages beneath friendly parallels in order to demolish them. After the discovery of such a passage, the miner could sink an intercepting tunnel; sometimes, the excavation of galleries was necessary in order to assault the fortified position by going under the ramparts as in the past, however; this became much more difficult with the progressive improvement in the construction of fortifications during the 17th and 18th century.

Contingents of pioneers began to appear on the battlefield during the Seven Years War (1756-1763). Initially, every infantry regiment contained a detachment of pioneers, often incorrectly called sappers, who provided combat engineering support during both offensive and defensive operations. These troops normally worked in small parties and were charged with such tasks as the building or breaching of field fortifications, the fortification or reduction of existing man-made structures such as buildings and walls within a village or farm, and minor road repair to include the construction of light timber bridges. Frequently, these missions had to be accomplished under-fire, when pioneers advanced with an assault force to clear obstacles or breach light fortifications. By the end of the war, some armies even

consolidated these troops into battalions so that commanding generals had the capabilities of the pioneer at their immediate disposal, thus allowing for their most effective utilization at critical points on the battlefield.

The pontoniers can be identified with field operations as early as 1689, when the Elector of Brandenburg crossed the Rhine with 20,000 troops over an improvised pontoon bridge. By the middle of the 18th century most standing armies had bridging trains and pontoniers while on campaign. Missions of these troops included the assembly of their pontoon bridges as well as the construction of heavy timber trestle bridges over any water obstacle which impeded the field mobility of the army. The equipment of the pontonier company consisted of approximately 20 to 30 pontoon boats of wood or sheet metal, each carried on a light two-wheeled cart or several carried on a four-wheeled transport, with anchors, breastlines, boathooks, and timber planking for the superstructure. The pontonier companies were normally attached to the heavy artillery trains and detached on a temporary basis for individual missions.

Although the value of the different military engineer organizations was only slowly and begrudgingly acknowledged, their influence on combat operations, together with improvements in artillery and the general increase in the efficiency and capabilities of the regular units of the standing armies, were making warfare far too complex for campaigns to be entrusted to military amateurism, as up to this point. As the management of armies became more complicated, by the mid-18th century, most of the dynastic governments realized the importance of specialized

knowledge by military commanders in the principles of warfare. This can be seen in the establishment of royal schools of formal military education such as the Royal Military Academy of Artillery and Engineering, England (1741), the Ecole Militaire, France (1751), the Wiener Neustadt Militiaerakademie, Austria (1752), and the Academie des Nobles, Brandenburg-Prussia (1765). Besides tactics, strategy, drill, and ceremony, these schools devoted many of their programs of study to techniques in field engineering, and to the disciplines of fortification, topography, artillery and mathematics. At first the nobility avoided these schools, and only the nobles who could not afford to purchase a commission and the bourgeoisie, when allowed, attended. However, with the middle class reaching a superior level of intelligence and wealth and also showing a sudden interest in military careers, the nobility felt their leadership monopoly challenged. Thus, towards by the end of the 18th century the nobility began to take education more seriously, in an attempt to gain a dominant level of attendance within the military schools.

This did much for final acknowledgement and an appreciation of military engineering by the leadership in the standing armies. In some cases the poor nobility even began to enter the artillery and engineer branches which, as a consequence of this change in attitude and of the demands of the Napoleonic Wars, was established at last. Nevertheless, the greater part of the nobility still did not consider these respectable or honorable corps. Thus, there was always room in these arms for the bourgeois officer but very seldom could he penetrate the ranks

of the better infantry regiments or, especially, the cavalry which the aristocracy continued to arrogate for itself.

In the various European armies the engineer branches were originally established as staffs of engineer officers which virtually had no troops under their command. Although, due to Vauban's fortification enterprise, the French had created the Corps des Ingenieurs de Genie Militaire as early as 1704, this unique type of organization was not adopted by the other European powers until the mid-18th century. Even though these staff sections were called "corps" they must not be confused with true branches or arms of service, for they had no permanent organizations under their administrative jurisdiction and, as discussed earlier, combat engineer units were mustered and attached to other branches during their period of service.

This condition would change abruptly with the outbreak of the French Revolution and a warfare of mass armies which was to follow. At Valmy (1792), the artillery saved the Revolutionary Army of France; mainly officered by the bourgeoisie it was virtually untouched when the army was purged of its aristocratic leadership. The same was true for the engineer staff section which had been amalgamated with all miner, sapper, and pioneer units into a single composite corps by 1793, in order to meet the military engineering requirements of the mass army. Realizing the effectiveness and importance of these arms for a 'levee en mass' army, the revolutionary leaders changed the precedence in the army (1797), giving the artillery the lead over all other branches, followed by engineers, infantry and cavalry. Clearly, the technical and unitarian considerations of the bourgeois had

gained a most influential position in military operations and, henceforth, would irreversibly alter the science of warfare forever.

Napoleon took the revolutionary organization a step further; his massed artillery, "Grand Batteries", dominated the battlefield, forcing armies to depend more and more on field fortifications. In addition, the enhanced mobility of the French armies made bridging and road repair an essential facet of any military operation. By 1812, all the major powers of Europe, with the exception of Great Britain, had also coalesced their combat engineering assets into permanent "Corps of Engineers" establishments, comparable in composition to the French. These corps consisted of separate companies or battalions of sappers, pioneers, miners or pontoniers, as in the French, Austrian and Russian Armies, or, as in the Prussian Army, of combined Pioneer Field Companies of miner, sapper and pontonier sections in a normal proportion of 1:2:1. In addition, engineer officers were frequently assigned as advisors in both brigade and corps headquarters. When deployed the combat engineer units were attached to other combat formations on a mission basis or for the duration of a campaign. However, frequently engineer "field parks" would be constituted from which armies and corps drew companies, or sometimes only detachments, on the basis of need. By the end of the war combat engineer units accounted for approximately one per cent of all troops on the battlefield.

The permanency of the engineer branches came about as a result of the military reforms, accomplished, in the Prussian

Army under the Scharnhorst/Gneisenau team, in the Russian Army under Barclay de Tolly's staff, and in the Austrian Army under Archduke Charles, as the allied governments attempted to cope with the absolute warfare of Napoleonic France. The expansive remodeling of these armies into national forces had been implemented with the intention of providing concessions to stimulate popular enthusiasm for the war effort, without endangering or weakening the existing dynastic order. Thus, even though the branches of artillery and military engineering were raised considerably in precedence and size in order to improve the combat efficiency of the army, and though the bourgeoisie entered the officer ranks of all branches in ample numbers, the aristocracy maintained martial control, however, far from exclusive. Consequently, with the end of the war and the restoration of the old order the nobility tried to regain that leadership monopoly in the army which they had enjoyed during the 18th century.

This refeudalization process faced little opposition from the bourgeoisie which generally was more concerned with exploiting new methods of industrialization or with their professions than with military service; they considered national militias little more than organizations which distracted from their main interests, private enterprise. Therefore, by the mid-19th century professional regular armies reappeared, with conscription being superceded when possible in favor of enlistment, and with the nobility once again predominating the officer corps. In the Romantic Movement, which prevailed throughout the literary world during the first half of the 19th

century, the aristocratic reactionaries directed this revolt against rationalism and Bourgeois materialism. Unfortunately, through their passionate appeals they gained popular support for a conservatism which isolated the army from those steady advances made in technology and machinery which in reality were germane to warfare. Even into the 20th century military innovations were accomplished only after great blood-letting or defeat had demonstrated their essentiality. In short, the mentality of feudalism once again permeated military thought; the officer remained a romantic, even in the industrial age.

Consequently, after the Napoleonic Wars, the embourgeoisement of the army was reversed and, with the exception of the French military system, only the engineer and artillery branches were open to be officered by non-nobles, who held up to 80 percent of the commissions. Once again, the combat engineer stood lowest in respect of the rest of the army. In Prussia the Pioneer Field Companies took over guard of the garrison when all other troops went on maneuvers. Great Britain still had no regular combat engineer units, while the Austrian combat engineers were often detailed to road and bridge repair instead of participating in the maneuvers and training with the other combat formations. In France, on the other hand, the precedence in the army had changed very little since the Napoleonic Wars; the elite of the nation was selected for commissions in the Corps de Genie Militaire before other branches.

Despite the renaissance of the professional army, conditions for its continued existence were soon displaced with the

emergence of the Machine Age in the later part of the 19th century. The major proponent and motivative force behind this transition was Prussia, whose process of industrialization during this period, coinciding with a population explosion, had too quickly gained momentum. As the bourgeoisie made startling advances in most other fields, the army stagnated. In order to keep pace and to maintain their social influence, the nobility pressed for a military apparatus which would once again allow for promotion and an adequate supply of positions, a much enlarged army. This, together with the desire of the military hierarchy to bring the army under the complete control of the King and his General Staff, led to army reorganization in 1861, accomplished under Generals von Manteuffel and von Moltke, during which the leadership of the army was doubled in size.

Integrating new technological advances, including railway and telegraph systems, the new organization, now managed almost absolutely by the General Staff, consisted exclusively of line regiments, manned at between half and two thirds enlisted strength at peace time. In time of need these were brought to full authorization by calling up the reserve. Thus, the regular army could expand by more than one third of its size within a month, allowing for numerical superiority over any other army in Europe, except for Russia. With the victories of 1864, 1866, and 1870 Prussia proved that the mass army was supreme on the battlefield. Before the turn of the century, all the major powers of Europe had in varying degrees espoused the Prussian model. Ironically, as Europe approached its first total war, industrialization had caused warfare and its preparation to pass

gradually from the exclusive control of the aristocracy to the bourgeoisie; with World War I this process would be completed.

The reappearance of mass armies and the improvement in weaponry hit significantly at the role of the combat engineer. Although their equipment and mission changed very little from the Napoleonic Era through World War I, their numbers and importance to combat operations increased substantially. During the first half of the 19th century tactics resembled those used in the Napoleonic Wars. Gradually, however, the blood-letting of the European and American conflicts of the 1859-1870 period drove home the realization that the increased range and effectiveness of the breech-loading rifle, permitting soldiers to bring down lethal fire from behind cover or from trenches and earthen redoubts, had made close formations obsolete. In addition, because rifle-fire caused such havoc amongst gun-crews, breastworks became essential for artillery when deployed in close-range positions. With the advent of the machinegun tactics were further complicated, forcing combat formations into field fortifications for survival. By the turn of the century, every army corps had one or two battalions of pioneers allotted, which consisted of sappers and miners, with horsedrawn transport for tools and equipment, and a pontoon train. Their tasks were modified to mining and field fortifications, while trench digging and barbed wire entanglements emerged as their primary missions.

At the outbreak of World War I, the combat engineers were initially employed in siege operations; however, this changed soon after the battle of the Marne (1914), when the War gradually

stagnated into a process of trench warfare. The fighting arms had been completely unprepared for the change in tactics and strategy and, as the war dragged on, they depended more and more on the technical assistance of the combat engineer. This need was further compounded with the employment of trench mortars and massed heavy artillery which forced the combat arms even deeper underground. As the war progressed the ratio of combat engineers to other combat units was far from adequate. By the time mine warfare and attack from the air reached a peak between 1916 and 1917, most armies had reorganized their engineer branches deploying the majority of combat engineers in battalion-size pioneer units at the division level. These consisted of a headquarters, several pioneer field companies, a searchlight section, and a bridging train. It was here, with the divisional battalion, that the combat engineer was initially employed in both effectively situated and large enough organizations to influence significantly combat operations on the modern battlefield.

Also during this period of the war, the dimensional development of combat engineering in general reached its zenith. In the German army alone, the number of pioneers in all ranks had risen to 170 000; their strength had almost tripled in size during the course of the war. After 1917, however, the armies met increasing difficulties in finding reinforcements and the war ended before the innovations of the tank and the aeroplane could make a major influence on combat operations. Thus, the conflict came to a close with the armies virtually deadlocked in trench warfare, and before the new divisional engineers really had the

opportunity to demonstrate their effectiveness in modern warfare. Their unique possibilities would be realized only after the theoretical and practical dialectics of their proper employment in mechanized warfare had been resolved; a process first initiated at the end of World War I and climaxing at the height of conflict in North Africa during World War II.

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FOOTNOTES

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CHAPTER II

THE DIVISIONAL ENGINEERS AND THE DEVELOPMENT OF MECHANIZED WARFARE IN THE ALLIED CAMP FROM 1916 TO 1940

During the last two years of World War I, the Allied armies were the first and only ones to employ armored formations to a significant degree. Their purpose was to tactically assist infantry and cavalry based offensive operations in breaking the deadlock of trench warfare, with the combat engineers providing indirect support through deliberate and static construction. The innovation of the armored vehicle prompted the formulation of a mechanized landpower theory in Britain, during the inter-war years, which advocated combined-arms armored formations as the key element in future warfare. The divisional engineer was given the essential roles of ensuring rapid maneuverability and of enhancing anti-tank defence. These new concepts were not assimilated by the traditionally oriented army leadership, which caused the Allies to enter World War II entirely unprepared to wage mechanized warfare.

Early Mechanization

During the First World War, the influence of combat engineers and artillery dominated the battlefield. It was siege warfare on a grand scale; in order to attack, combat units had virtually to trench forward and then assault an enemy who, in elaborate field fortifications, could easily channel and contain such offensive movement with barbed wire and then decimate it with machine-gun and massive indirect artillery fire. The highly

cherished arm, the cavalry, became useless and the vulnerability of the infantry in massed attack formations made them completely ineffective against this seemingly impenetratable defense system. Military leadership, inhibited by their aristocratic, chivalrous notions of honor and glory, and with little practical knowledge of or experience in this type of combat, was unable to comprehend the importance of mechanics and technology in modern warfare and thus lacked the imagination to assimilate the products of the Industrial Revolution into it. Throughout the War, the former dynamic combat arms, infantry and cavalry, were unable to break the deadlock, which made them almost completely dependent on the support of the engineer and artillery man for survival.

The generals, without the propensity for the use of mechanical aid, employed outdated tactics resulting in catastrophic waste of human life. Consequently, especially in the Entente countries, France, Britain, and Russia, this led to intervention in the direction of the War by civilian governments. Unlike the preindustrial armies of the 19th century, warfare between Nations-In-Arms,* witnessed for the first time during World War I, depended completely on popular support and morale. As the conflict evolved to a warfare of mass production, it gripped all national activities, and war became an extensive national business, supported by a regimented, all inclusive military industrial complex, the management of which reached far beyond the capabilities of a military command organization.¹

*A Nation-In-Arms has an army organized around the trained civilian reserve, which is ready immediately to supplement the standing army at the outbreak of war.

While the generals called for more rifles and bayonets, the politicians realized the need for employment of modern industrial principles in warfare. As the conflict dragged on, the civilian leaders expanded their influence over the conduct of the War and, in most cases, insisted on the development and integration of war machines into combat operations.² Even so, the aristocratic mentality could not grasp the significance of the new devices; thus the submarine, the airplane, the tank, chemical agents, etc. were experimented with but never dynamically employed. These conditions set the background for the birth of mechanized warfare.

It was also during this period that the more intellectual, non-aristocratic officers, a group which had seriously followed military careers since the last quarter of the 19th century, began to exert their influence within the armies. New blood flowed in many of these junior leaders who, although only holding positions such as chiefs of staff, division, or regimental commanders, fully appreciated the role of mechanization and, as war technologists, aligned themselves with the more scientific approach of the civilian leaders to break out of the static warfare surrounding them. It was from this generation, the leaders of post World War I and World War II, that a selected band of advocates rose and carried the development of mechanized warfare from its experimental stages to reality.

This small group of military men, most of whom came from the technical arms, should be credited with taking the tank to the battlefield. The British were the main proponents of the new war machine, with the two Royal Engineer officers, Lieutenant-

Colonels H. J. Elles and E. S. Swinton, pioneering and commanding the first armored unit³, which, by May 1917, had evolved into a separate tank corps. This formation was developed purely as an auxiliary to spearhead the infantry attack and provided a bullet-proof device capable of eliminating the machine-gun and of smashing through field fortifications or barbed-wire entanglements. This allowed the infantry and cavalry to penetrate the enemy's main trench system and, through this break, to roll up his flanks and to continue the advance in a mobile warfare, beyond fixed defences. At Cambrai (Nov.-Dec. 1917), these tactics were employed properly for the first time; unfortunately, the attack eventually failed when cooperation between tank and infantry units broke in the face of enemy counter-attack.⁴ Nevertheless, the importance of the tank had been proved. Before the War's end, the offensive employment of tanks on a massive scale was being planned. In "Plan 1919", the Allies intended to strike a 90-mile front with a combined British, French, and American tank force spearhead consisting of 4,992 tanks. Besides the customary infantry, artillery, and cavalry formations, this operation included motorized infantry and tactical air support.

The engineers' duties during these initial armored offensive operations was limited to improving mobility of rear-area and follow-on communications and the construction of roads, railroads, and bridges.⁵ However, after the tank units encountered serious difficulties in crossing trench systems and with the assumption that the Germans would resort to large-scale

land mining, a few land mines having already been used in 1918⁶, the Royal Engineers took the initiative to equip themselves for support of armored assaults on fortified positions. Special engineer tanks were developed⁷, capable of tasks such as barbed-wire entanglement removal as well as the transport and emplacement of a 35-ton, 21-foot tank assault bridge. By October 1918, the first mechanized engineer units were formed at Christchurch, three battalions, each equipped with 48 of these special bridging tanks and twelve strong bridges to take the heaviest tanks. These units were hardly established when the War ended resulting in the disbandment of two of these battalions.

The remaining battalion, under the command of Lieutenant-Colonel G. Le Q. Martel, was reduced in size, after the Armistice, and renamed "The Experimental Bridging Company". In 1919, this company designed and tested a new engineer tank prototype capable of propelling a heavy steel roller in front of the tracks for detonating anti-tank mines without damage, of pushing a 70-foot heavy bridge mounted on idle tracks which could be launched under fire, of clearing barbed wire obstacles with grapnels, and of firing demolition charges suspended from the front derrick. Although never adopted by the army, this piece of equipment represents the foresight possessed by many engineer officers⁸ at a time when most other arms continued to think along conservative, non-mechanized lines. The Experimental Bridging Company remained as the only armored assault engineer unit in the world well into the 1920's, when the special bridging tanks became obsolete and armored units began to practice mobile operations in which the heavy 1917 tanks of trench warfare could

not keep pace.

Although the engineer arm of other armies had experimented with various devices of mechanized warfare, none had gone nearly as far as the British Royal Engineers. But even this progress was soon stifled when in 1923 the program of assigning special engineer officers to the Royal Tank Corps was abolished, thus eliminating the engineers' participation in further research and development of armored operations. In spite of the advances made by the engineers in the Royal Tank Corps, organization and equipment of all other divisional engineer units had changed very little in the British as well as in all the other European armies. The combat engineer organization throughout the 1920's was virtually identical to that of the late 19th century in many aspects including the types of personnel, tools, equipment, and horse transport.⁹ In most armies this state of combat readiness, including that of the engineer arm, existed right up to World War II.

Theories of the Military Intellectuals

The degree of mechanization that was accomplished can be attributed primarily to the military intellectuals and disciples of mechanized landpower who, as stated earlier, were the junior leaders during World War I. This select group fully realized the potential of the new war machines and strove to convert the military leadership to mechanized warfare, in the hope of avoiding future senseless slaughter by reviving mobility and offensive maneuver. The fountainhead for this movement developed

in Great Britain around the unofficial military intellectuals such as Colonel J. F. C. Fuller, Captain B. H. Liddell Hart, and the two Royal Engineer officers, Lieutenant-Colonels P. Hobart and G. Le Q. Martel who were both destined to be division commanders during World War II. All these officers, with the exception Liddell Hart, had gathered practical experience with tanks, either during or immediately after the War. Together, through their publications and associations, they would develop the blueprints for mechanized warfare which, ironically, would put into practice with perfection by the German army in the Blitzkrieg operations at the beginning of World War II.

At the beginning of World War I, the purpose of the tank units was to act as an auxiliary force by helping the infantry to penetrate and clear successive lines of trenches.¹⁰ Surprise was gained in the armor supported attack, since now the tank could take over the former artillery tasks of destroying wire obstacles and of covering the advance of attacking forces. The tank spearhead led the sudden, head-on attack through the wire, the infantry following by sections in single file using the tank's protection against direct-fire weapons. An indirect artillery barrage waited until after the infantry attack was launched and fire lifted in accordance with the planned rate of advance. Once through the wire, the tanks either turned or crossed over and turned down the trench systems and engaged the enemy occupants, with the infantry performing a mop-up mission and assaulting strong points. After the establishment of a gap, the cavalry passed through to seize strategic areas, far to the rear. This advance was followed by breakthrough infantry formations which

could reinforce any gains.

In the early stages of their theories, the military intellectuals realized that a more powerful penetration and pursuit could be attained if tank formations instead of cavalry seized the strategic objectives. This was reinforced, especially after the cavalry failed at Cambrai, when it could not be moved forward quickly enough to exploit the breakthrough, due to their vulnerability. In addition, the attack lost momentum when the follow-on infantry could not keep up with the tanks after penetrating the defensive line. The tank formations themselves faced serious problems when 179 of the 378 tanks fell out of the attack during the first day, 71 due to mechanical troubles, and 43 were eliminated through ditching. Obviously, an independent tank force was needed, capable of making a penetration and exploiting the breakthrough afterwards. It was this realization that led Martel, Fuller and Hobart to formalize the initial concepts of mechanized landpower.

Martel, Brigade Major of the 2nd Tank Brigade at the time, was the first to theorize about armored forces.¹¹ He saw tank forces operating like a naval fleet, where the mission of the tank was to seek out and destroy the enemy's tanks. These tank formations operated from (and were supported by) static "tank bases", much like a naval base, protected by anti-tank trenches, landmine belts, and "pillars of wood or concrete sunk in the ground to form an artificial forest". The armored forces were accompanied by combat engineer and signal units, also mounted in tanks designed to assist them in their respective missions. One

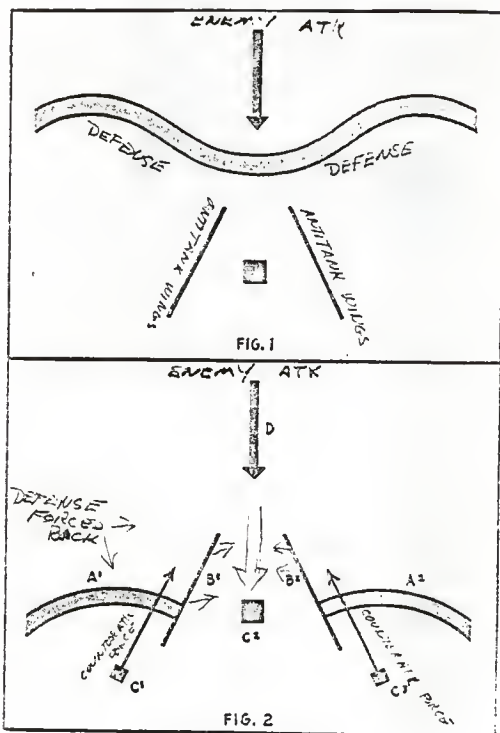
can clearly see the influence of Martel's professional combat engineering experience on his theories. He can be cited as the originator of such famous obstacle concepts as the anti-tank ditch, the minefield belt, and the dragon's teeth, which were perfected in the 1930's and 40's, and are still today the most effective anti-tank obstacles available to the combat engineer. Although he had defined the engineer mission in armored warfare, his theories were far from specific. Of more consequence was Martel's influence on Fuller who, in turn, would take his ideas a step further and establish more detailed instructions on how these theories should be accomplished.

Fuller's concept resembled Martel's in that it espoused the idea of mobile armies exercising a decisive influence on the battlefield through the combination of fire-power, mobility and protection. His fundamental concerns, however, were the details of tactics in armored warfare, and the most advantageous organization and employment of the arms involved. His initial ideas are discernible in Plan 1919¹² in which he proposed to attack the enemy's will to fight instead of his physical ability to do so. Once the breakthrough was made, light tanks 'en masse' and motorized infantry would quickly move in behind the enemy on each flank, head directly for the respective army corps' and divisional headquarters to assault command and control centers, establish systems of machine gun positions which would isolate the forward garrisons from their supply and reserves, and ultimately cut an entire army or group from its command, commander, and staff. Without these essential communications the combat units would be paralyzed and forced to surrender when

faced with determined, carefully mounted tank, infantry, and artillery attack against their front. Thus, the command organization was the primary target in Fuller's mind.

During the 1920's, Fuller's ideas were finalized in more concrete and technically specific terms.¹³ Holding true to the naval concept of mechanical warfare, he advocated that linear warfare should be replaced with area warfare. In this kind of conflict, the army should be organized into a mechanized force (consisting of reconnaissance and main battle tank formations, small and mobile, light or medium in class) which acted as a dynamic combative entity, and the non-mechanized force (consisting mainly of mass non-mechanized infantry formations) which followed up on battlefield success and consolidated gains. The defence was just as vital as the offence in combat operations. As in Plan 1919, the primary mission of the mechanized force was to destroy the enemy's morale by conducting deep, disruptive penetration into his rear, aimed at paralyzing systems of command, control, and service support. The mechanized forces, operating as independent organizations, were divided into both a tank wing, consisting of reconnaissance, artillery, and combat armored vehicles, and an anti-tank wing, composed of transportable anti-tank weapons, both highly mobile and well armed for mechanized combat. During the advance, the tank was to lead the anti-tank wing. However, once halted, the anti-tank wing was to establish immediately a "waagon laager", defended by machine-guns, anti-tank guns, minefields, and field fortifications to shelter auxiliary support units, and to serve

as a base for the tank wing. From these "waagon laagers" the tank wing could sally forth to attack or seek refuge in them when counter-attacked and forced to retire. The prime example of this type of laager is the funnel formation which defended a salient.



Figures 1 and 2: Defensive Base from which Mobile Forces can Operate. See footnote 14.

When used in conjunction with engineer anti-tank obstacles, it could very effectively regain the initiative for the tank wing's attack by slowing, channelizing, and then neutralizing the enemy's thrust through the coordination of mobile with static defence.

First, a zone of defensive works should be constructed across the base of the salient, so that, should the enemy penetrate its flank, its defenders will have a line of resistance to withdraw to. Secondly, defensive works should be thrown up on the flanks of the salient, forming a protective funnel. These, in the case of armored formations, should be manned by the anti-tank wings. Then, when the [covering forces] working outside the salient [are] compelled to fall back, it should do so on the flanks of the salient, as shown in Figure 2. In Figure 1, the [reconnaissance screen] is still out, but is being driven in. In Figure 2, it is shown by letters A^1 and A^2 , whereas B^1 and B^2 are the defended wings of the funnel. The mobile troops should be divided into three groups C^1 , C^2 , and C^3 , of which C^2 is within the salient and C^1 and C^3 outside it and on its flank. Then, should the enemy - D - penetrate between B^1 and B^2 , C^2 can advance and engage him, while C^1 and C^3 attack him in flank and rear. Should the enemy attack B^1 , then C^1 can operate against his right flank, while C^2 , or part of that force, operate against his left flank by advancing up the funnel and moving out of it. The same maneuver should be carried out, if the enemy attacks B^2 . The secret of this particular distribution is: [1] it establishes a defensive base from which the mobile forces can operate, and [2] it induces an enemy to offer a flank to counterattack.¹⁴

During defensive operations, Fuller adhered to the area principle as follows. The anti-tank wings were to establish a defensive system of mutually supporting strong-points where all inner flanks between these positions were covered by overlapping anti-tank fires and anti-tank obstacles. They were fashioned in such a way that they would channelize the enemy offensive into areas where he could be counter-attacked with advantage by the

tank wing, not necessarily to counter-attack an enemy force which had broken through the defensive system.¹⁵ The tank wing, the mobile counter-attacking force, was kept in the rear and towards the exposed flank of the defensive system for such purposes. These defensive systems were to be developed in and around areas where the terrain and natural obstacles favored mobile defence and allowed for depth. In open country, the anti-tank wings had to establish an all-around defensive perimeter. It was in the defence that Fuller saw the great value of combat engineering.

It is interesting that a light infantryman such as Fuller would put more emphasis on combat engineers than on his own arm. He saw no value of the infantry in the mechanized force, except for being what he called "field pioneers", to assist in the construction of field fortification, but he asserted the importance of the combat engineer for the support of both the tank and the anti-tank wings. In defining the engineer support mission for mechanized warfare, Fuller picked up where Martel had left off by specifying further their function.¹⁶ Differing somewhat from his predecessor, he put the combat engineers only in the anti-tank wing, in which they were to be both motorized and mechanized. To assist the combat engineer in accomplishing his mission, he saw the need for such counter-mobility equipment as anti-tank trench diggers and minelayers, and mobility equipment such as minesweepers or exploders, flame-throwing tanks, assault tanks, and bridging tanks. Generally, tank operations were based on two categories of anti-tank auxiliary troops, one consisting of artillery anti-tank forces, the other

of combat engineer mine layers, anti-tank trap, and obstacle constructors. Although the combat engineer was primarily concerned with anti-tank operations, he also was to be interested in enhancing friendly mobility, cover, and protection.

To Fuller, these concerns were all interrelated, for he believed that the advent of small, fully mobile forces would make it easier to maneuver around hostile flanks and ultimately to assault rear areas. This generated a greater need for field fortifications and anti-tank defences, not only to defend logistical bases and headquarters but also to block narrow avenues of approach and key terrain, much as the fortress systems had done up until the mid-19th century along routes of communication. Thus, improvement in mobility increased in area field defences in depth; the need for combat engineers in mechanized warfare would be equal to, if not greater, than it had been in World War I. The combat engineer, however, still was an auxiliary force and limited in the support of a virtually all-tank concept of warfare, and, due to its vulnerability, primarily left under the protection of the anti-tank wing.

In the defensive mode, the combat engineer should be mainly concerned with **counter-mobility***, field fortifications, and the improvement of defences, with obstacles being emplaced and erected to impede the attacker. Systems of interlocking strong-points shielded by minefields would replace entrenchments protected by barbed-wire entanglements.¹⁷ When possible, anti-tank obstacles were to be immediately in front of dug-in

* Bold printed expressions are included in a list of definitions at the beginning of this thesis.

positions and covered by fire, and joined with natural obstacles such as rivers, sunken roads, ect.. Minefields were to consist of rows of mines laid diagonally to halt and deflect movement and were to be covered by dug-in anti-tank weapons. To prevent infantry infiltration, barbed wire fences could be erected. In addition, anti-tank trenches or slits (10'L x 2'W x 4'H) should be excavated to block high speed avenues of approach onto the anti-tank defences. Besides assisting in their construction, Fuller considered the combat engineer primarily responsible for planning and coordinating the placement of anti-tank defences, ensuring that the anti-tank obstacle systems would allow for effective mobile counter-attack and that all obstacles were covered by interlocking fields of fire. He fully realized that an obstacle not covered was ineffective.

Once the tank wing counter-attacked the special engineer tanks would accompany them to support mobility over natural obstacles such as rivers and to accommodate assaults through man-made barriers including anti-tank ditches, minefields, and road blocks. If the attack was successful, the anti-tank wing would close in behind the tank wing so the advance could continue. This process repeated itself until the mission was accomplished.

Clearly, Fuller saw mechanized warfare as a contest between highly mobile all-tank formations, putting little value in the anti-tank gun and the airplane as offensive weapons. To him, the plane was a reconnaissance aid and the anti-tank gun a primary defence support weapon, the infantry a mop-up and occupation force. Although Hobart refined Fuller's theories and experimented with some of these assets, Basil Liddell Hart was the theorist

who would incorporate these final elements into the Blitzkrieg formula.¹⁸ The ideas of Liddell Hart contrasted with those of both Martel and Fuller only in that he envisioned the mechanized force as an integrated, combined-arms team, where all arms, including a significant portion of mechanized infantry (in armored carriers with anti-tank guns), amalgamated their specific capabilities in combat operations. It was the first theory which awarded the infantry (Hart labeled them "Tank-Marines") as well as the auxiliary combat arms an important role in offensive operations.

Liddell Hart's intention was to inject opportunism into mechanized warfare, with independent, self-sufficient, mobile combat teams, incorporating all arms and thus capable of dealing with all possible situations which might be encountered on a fluid, modern battlefield. Supporting arms were to be fully mechanized and permanently attached to a tank/mechanized infantry (anti-tank) oriented divisional force. Thus, this composite, versatile formation possessed the spontaneity of action to attack the enemy almost anywhere at any time. Liddell Hart saw that the chief advantage of such a force, employed as a spearhead, was that it could feel out enemy weak points and exploit them, no matter where they were located and, much like a stream, follow the avenues of least resistance, that of the "expanding torrent". The successes were to be consolidated by the follow-on motorized and non-motorized divisions. The "expanding torrent" mission required a new formation which he called the New Model Division, organized into three composite brigades and one support brigade.

The composite brigade consisted of one heavy tank battalion, one medium tank battalion, and three battalions of tank marines. The support brigade included artillery, engineers, signal, motor transport, and pertinent service troops.¹⁹

Liddell Hart also applied to mechanized warfare what he called the "baited gambit", which was essentially an offensive strategy combined with defensive tactics:

You may be able to seize points which the enemy, sensitive to the threat, will be constrained to attack. Thus you will invite him to a repulse which in turn may be exploited by a riposte. Such a counterstroke, against an exhausted attacker, is much less difficult than the attack on a defended position.²⁰

It was a strategy of luring an opponent to attack your force while you had your defensive advantage and then, after his assault failed, launching a tactical offensive to destroy his enervated forces before he could recover. It was a highly fluid, fast paced operation, in which the speed of the tank was to be used to the utmost. However, the existing heavy artillery, essential for defence, was not suited for mobile warfare. This convinced Liddell Hart that greater emphasis had to be placed on the combination of tanks and aircraft. The use of tactical air support to strafe and bomb the enemy would be a potent substitute for heavy artillery in mechanized warfare.

In most respects, Liddell Hart agreed with Fuller, but his concepts tended to give a more realistic estimation of how mechanized warfare should be conducted on the strategic level. For this reason, Liddell Hart's concepts significantly influenced the combat engineer mission. Supporting a highly mobile, armored

formation as an equal partner, placed requirements on the engineer far different from what had traditionally been expected. First, to match the tempo of Liddell Hart's strategy and tactics, almost the entire combat engineer force had to be mounted in vehicles of comparable mobility and protection to those serving the combat units,²¹ namely, armored cross-country troop carriers. Second, the engineer's training and equipment had to be modified to support **hasty**²² but effective field fortification construction, obstacle emplacement, and assault breach/river crossing operations.²³ Combat engineering techniques had to be simplified and streamlined but, at the same time kept efficient and effective. The troops had to be organized and thoroughly indoctrinated for fast paced operations. In addition, modern equipment, transportable, durable, heavy duty, rapidly erected or put into operation, and completely mechanized, was of paramount importance.

Operations of a **deliberate**²⁴ nature would not be suited for this type of warfare, so that a fundamental readjustment to the demands of the new tactics had to be made. Traditional, cumbersome, and luxurious counterment had to give way to field expediency and operability. The engineers, being one of the most equipment heavy arms, had to adjust more drastically to this change of mission than most other branches of service. Representing both, the mobility and counter-mobility forces, the combat engineer had to keep the friendly stream flowing by busting the dams of man-made or natural obstacles in its path, and build the dam that would slow down the enemy stream. To accomplish these tasks, the combat engineers needed modern

pontoon bridging (heavy enough to carry tanks) for assault river crossing, air compressors for powering engineer mechanical devices, materials and equipment for the breaching or installation of battlefield effective obstacles (such as minefields, road craters, tank ditches, abatis, wire entanglements, and bridge demolitions), and armored cross-country vehicles to carry the combat engineer with equipment on his mission. Much of this equipment was available on the civilian economy but almost none of it was carried on army inventories. Experimentation was accomplished, however, and here again the British led the way.

British Development of Mechanized Warfare

As early as 1923, the British army had been tinkering with tank formations. One year later, at Aldershot, the new Vickers Tank* had made its debut and dominated the battlefield due to an almost total lack of special anti-tank weapons, and the lack of progress made in special anti-tank training since the inception of armored vehicles.²⁵ In 1926, however, the army began to experiment seriously with mechanized warfare, to include organization and techniques of employment, utilizing the limited funds available. Consequently, with the influence of the mechanized landpower theorists in full sway, the "Experimental Armored Force" was formed in Salisbury Plain (1927) and put under the command of Brigadier-General R. J. Collins.²⁶ The Force was

*Vickers Medium Tank MKI: The first British service tank to have all-round traverse and geared elevation for the 3-pound gun; could cruise at 20 miles per hour; 11.7 tons.

patterned after the Fullerite concept and composed of one battalion (equal to 48) Vickers Tanks, one field artillery brigade (tractor drawn), one light battery (with guns on trucks), one machine gun battalion (in cross-country trucks), one motorized field company (Royal Engineers), and one signal company. The training exercise revolved around three kinds of maneuvers: strategical reconnaissance in place of independent cavalry, cooperation with main forces, and an independent mission lasting up to 48 hours. The Force spent most of its efforts in coordinating movement together, the slowest and least protected worrying about survivability while on the move.

The engineer element, No. 17 Field Company R. E. commanded by Major Martel, was such a problem unit. It was motorized using 3-ton trucks and 30-cwt. trucks to transport men and equipment, including an air compressor and sufficient pontoon equipment for bridging the small rivers about the plain.²⁷ The most significant accomplishment of the combat engineers during this experiment was to demonstrate that river obstacles would not necessarily be a major deterrent to tank operations. A new device, light timber "stepping stones", was tried for the first time. It somewhat resembled the paddle wheel of a river boat and, when several were dropped into a stream or anti-tank ditch, tanks could cross over them.²⁸ Crossing were also made over an improvised 60-ft. light box-grinder bridge and the pontoon bridge. Strangely enough, no anti-tank devices or methods were tested, with mobility being the only concern. In addition, no steps were taken to introduce an armored combat engineer force, a concept Major Martel himself had proposed. With the lessons

learned from the maneuvers, it was hoped, however, that the entire Force would be armored, but this scheme was far ahead of its practical possibilities and never got a trial, as the "Experimental Armored Force" was disbanded in 1929.

For Britain, the demise of the Force marked the beginning of a turning point in the development of both doctrine and strategy. In the following ten years the War Office would literally turn a deaf ear to, among others, Fuller, Hobart, Martel, and Colonels C. Broad and G. Pile of the Royal Artillery advocating the development of an armored division and continued to believe in obsolete concepts. In a way, mechanization had progressed as far as it possibly could have in an army based on 18th and 19th century mentality. The British regimental system, limited to the infantry and cavalry, had ceased to be a functional organization with the mechanization of warfare, especially in combined arms operation. But the regiment, where the true loyalty and pride of the British soldier was centered, was a tremendously influential entity and, in the 1930's, it was too early to try to superimpose a corporate spirit, as required for mutually supportive arms in a modern Blitzkrieg. Yet that was a step necessary for the success of a divisional organization.

The technical branches such as the artillery and the engineers, however, generally were more oriented towards their arm than towards their assigned unit and were already organized for and indoctrinated to a support role. In the case of the engineers, this can be attributed to the fact that their command and control was centralized in the Commander Royal Engineers

(CRE), who was responsible for the general direction and control of engineering tasks throughout the entire division. This organization encouraged a perspective for engineering matters which reached beyond the regimental level which made this service arm quite ready for change. A similar system existed for the divisional artillery. Thus, the promoters of mechanization came mostly from these arms. Unfortunately, the army leadership was dominated by cavalry and infantry which, understandably, despised the growing infringement of the technical arms on their traditional superiority. Moreover, after World War I, few at the strategic helm believed another major war was possible and, by the 1930's, the British army had reverted back to its traditional role of the colonial police force, a mission that could easily be accomplished without mechanization, especially when the economy was paralyzed by inflation and depression.

It took the Munich Crisis of 1938 to free the army from 20 years of military decadence, but by then it was too late. The following correspondence from General Squires,²⁹ the Director of Staff Duties, reflects the official view of tank employment as late as 1937 (the Tank Corps had permanently been reestablished in 1933 under the command of Hobart) and resembles actual operations in Belgium and France in 1940:

I. The Mobile Division (excluding the Tank Brigade) has the task of protecting the Main Field Force when on the move and medium reconnaissance at all times. It would thus find itself between the Main Force and the enemy until the battle front was formed at which moment it would be withdrawn.

This was nothing more than the reshaping of the old role of the

horsed cavalry screening function, except that now they were mounted in light tanks (most light and medium tank formations were to be established by redesignating horse cavalry as mechanized cavalry and by issuing them tanks).

II. The Tank Brigade (kept separate from the Mobile Division) would have the task of striking a heavy blow at an opportune moment, exploiting success or carrying out deep raids, because the increased power of anti-tank weapons was all the time whittling away the power of tank formations, the chances of the Tank Brigade prosecuting its role successfully are getting more remote with passage of time.

It was a doctrine of again making the heavy tank an auxiliary to infantry based operations. These official views of light and heavy tank employment were exactly the same as those the French were espousing, if not for identical reasons. They were not in the Blitzkrieg tradition.

French Development of Mechanized Warfare

France emerged victorious but completely shell-shocked from the World War.³⁰ The casualty lists produced by General Nivelle and others with their "attack always attack" policy had created an offence-phobia. This, combined with the fact that the heroism of Verdun represented almost the only glorious exploit to reflect on, caused the French to develop a "worship of the defence" mentality. Petain, made Marshal of France in 1919 after his victory at Verdun, carried the Higher War Council along with this mood by endorsing a purely defensive policy which enhanced his prestige but also dealt the death blow to mechanization. His influence became colossal and prevailed even over his disciple

Weygand who was handed the leadership of the Army in 1930. In 1935, the hero of the Battle of the Marne, General Gamelin, took over. He, like his predecessors, fraternized the mood by supporting the tactics which had gained him fame some 20 years before. Thus, throughout the inter-war years the defensive methods of 1918 became the cornerstone of the French doctrine. In 1921, Petain reflects this attitude clearly: "Tanks assist the advance of the infantry by breaking static obstacles and active resistance put up by the enemy."³¹

The French strategy would go on the offensive only after the enemy had been stopped before formidable static defensive systems. In the counter-attack the heavy artillery would function as the vanquishing force and the tank supported infantry as the occupying force. The whole of the advance, operated at the speed and maneuverability of muscular (man and horse) power with its age-old dependence on road networks until the railroad could be brought into play to supplement movement partially. The efforts of both General Estienne and Colonel de Gaulle to bring Fuller's concepts to practice in the French army were not only hindered by the existing psycho logical milieu and military traditionalism (As in the British army, mechanization was seen as a threat to the precedence of the traditional combat branches.), but also faced political obstacles. Since mechanization with its reliance on highly trained technicians leaned more towards a professional than towards a conscript armed force, an army based on armored formation was perceived to represent a danger to the Republic. Furthermore, static trench warfare would allow for protection even from temporary evacuation of the Nation's

productive means along the border with Germany.

With the start of the Maginot Line in 1929, these attitudes were "locked in concrete" and the concept of a mobile war was not considered thereafter. This is evidenced by Minister of War General Maurin's statement made as late as 1935, "when we have devoted so many efforts to building up a fortified barrier, is it conceivable that we would be mad enough to go ahead of this barrier into I know not what adventure?"³² It was French anti-militarism and apathy which ultimately harnessed the army to the 1918 concepts of warfare and caused the development of armored operations to progress even slower than that of their British counterpart.

The Divisional Engineer and the Allied Potential for Mechanized Warfare

The aversion of the leadership in both France and Britain to the principles of the mechanized landpower advocates and to the progressive assimilation of modern equipment and weaponry can also be understood when considering that these nations enjoyed a considerable military superiority over Germany until 1935, when Hitler denounced the military clauses of the Treaty of Versailles. In the same year, Italy invaded Abyssinia. It was only with the emergence of German and Italian militarism that they slowly implemented programs of rearmament and began to consider, in earnest, the theories of mechanized warfare which the totalitarian nations had been developing for some time. However, these reactions, which had begun to show real progress

only by 1938, came too late and were years behind the Germans in research and practical experimentation. To turn around the military decadence of 20 years in less than two years was an impossibility for any army of this time.

When the Allies marched into World War II, they did so at a 1918 tempo, with the few existing mechanized forces tailored for such combat.³³ Mobile formations were not only subordinated to cavalry and infantry arms but also almost completely segregated into either Motorized Infantry Tank divisions, with the organic combat support or service support elements for both being mounted in unarmored, road-bound motor transport. The Allied mobile units thus were anything but autonomous forces, logistically tied to the road networks and generally unprepared for sustained cross-country independent operations. Mobile combined operations were possible only along avenues supported by existing routes of communication and when not in direct contact with the enemy, since only the tank troops were afforded armor protection. However, even under favorable conditions, integrated efforts were questionable, since the units were not only unaccustomed and untrained to function in this manner but, in addition, were doctrinally unprepared.³⁴

Conceptionally, tank formations in the British army were to be solitarily employed to find and defeat the enemy's armor or, as in the French army, to support infantry operations. Motorized infantry was utilized only to assist in consolidating deeper armored gains until the non-motorized infantry could close on the objective, thus allowing the over-all action to continue. To accomplish this it was necessary for main battle tanks to be

shielded by thick armor, making them immune to anti-tank weapons and causing them to be very heavy. Speed was a minor consideration with tank formations moving at the pace of the non-motorized arms which they supported. Light, fast tanks were employed only to screen the main combat formations in support of independent cavalry operations; accordingly, these formations were too vulnerable to be used in close combat. Thus, the Allies generally developed slow, heavy tanks for combat which lacked both the speed and the wide radius of action necessary for mobile warfare. Infantry and combat support elements of mobile formations lacked both the effective anti-tank capability and the cross-country armored vehicles to allow them to act offensively in conjunction with the tank forces, since they had not been intended to do so.

These doctrinal deficiencies obviously affected the combat engineer mission. Divisional engineers were generally indoctrinated to be committed in a general support role, with the divisional engineer staff responsible for coordinating and planning all engineer operations, thus eliminating any close collaboration between the combat units and the engineers sent to support them. Such a system of control hindered the combat engineer from acting extemporaneously to the needs of other combat arms when actions of opportunity presented themselves, especially on a fluid battlefield where freedom of action even at the lowest levels of command is essential. As it was, the combat engineers normally were employed within the division as intact, independent companies (two or three to each divisional size unit), and very rarely assigned missions requiring the attachment

of combat engineer sections (platoon size elements) to subordinate formations.³⁵

The engineer battalion command was more or less a staff section which acted as the advisory, supervisory, and coordinating agency between the divisional and engineer company commander(s). Consequently, the engineer assets within the division were not prepared to function together on battalion-size missions, since there was no battalion headquarters organization which included an organic service support/command and control structure, required for such independent battalion operations. This further limited the combat engineer in his capacity to support mechanized operations, especially during assault actions when assets beyond the company capability might be needed,* and in delaying operations when the coordination of effort and resources is critical. Furthermore, engineer materials and equipment could have been located forward in anticipation of use and more easily shifted from company to company (i.e. sector to sector) through the coordination of an engineer battalion headquarters with independent communications capability.

The efficiency of combat engineer management in mechanized warfare was further debased by a lack of comprehensiveness in integrating engineer support with the actions of the other arms in divisional operations. Instead of being integrated, planned,

* The engineer battalion headquarters (the battalion combat engineer specialized) equipment sections are best utilized when their pooled assets can be provided temporarily to the line companies for specific missions, since maintenance and repair on unique types of vehicles is difficult, especially below the battalion level of maintenance support.

and, from the highest level of the staff organization and down, engineer support in terms of mobility and counter-mobility was almost wholly left to the initiative of the engineer staff section, whether at the division, corps, or army level.³⁶ Thorough coordination and command interest through each phase of an operation, however, was absolutely necessary, simply because the combat engineer companies could not support operations across the whole division front, both in width and depth, without being programmed, and provided with time, resources, and the ongoing-mission requirements in a timely manner which often necessitated sacrifices in convenience of the other arms. This held true, especially in the case of advance or withdrawal, when communications were least efficient; the Allies relied almost completely on wire as opposed to wireless communications. In this case, the only means of communication from the engineer staff section to the company was through a messenger, normally sent to a non-affiliated headquarters in the vicinity. Both, the lack of wireless signal and an engineer conscience staff system left the combat engineer with ineffective management and further encouraged impediement of action. This is attributable to the protracted warfare which the Allied armies were prepared to wage.

The function of the Allied combat engineers on the battlefield consisted of deliberate operations only. Heavy artillery and tanks were to be employed in slow, methodical, and lengthy involvements on the offensive to batter down the enemy's field fortification, barbed wire entanglements, expedient anti-tank defences (very few of which were anticipated), and gun emplacements.³⁷ Thus, the combat engineer's energies were

primarily reserved for maintaining routes of communication with the forward combat units and for assisting in the construction of more static type defensive works. With the exception of bridge demolitions, hasty engineer operations were not considered necessary under such conditions. The divisional engineers were unequipped and untrained for anti-tank or blocking actions of a fluid nature, especially in a combat environment.³⁸ They had no training in landmine warfare, had no mechanical devices for detecting or clearing such mines, and were issued only a few, if any of these explosive charges in their basic loads of ammunition.³⁹ Although other types of anti-mechanized-obstacles such as tank ditches, abatis, road craters, and log obstacles had been considered, training for their construction had not been actively pursued.

Even if these aspects of combat engineer operations had been mastered the lack of equipment would have prevented their accomplishment. Units were furnished with either two-wheel drive unarmored trucks or horse-drawn wagons and these over-laden vehicles* were incapable of cross-country travel and far too vulnerable for operations in close contact with the enemy. In addition, they had no anti-tank weapons and few machineguns to cover their work sites, including travel to and from them. This restricted the combat engineer's movement into those areas in which blocking and anti-tank operations could be most effectively

*Combat engineer transport generally were luxuriously inundated with tools, devices, and stores necessary in deliberate but excessive for hasty operations.

accomplished in conjunction with those combat units responsible for providing fire cover for these types of obstructions. Consequently, engineer obstacles could not be tied into defences unless they were constructed behind the line of contact and hours or days in advance of use, a situation highly unlikely in mechanized warfare.

The bridging equipment carried by the combat engineers was also intended for the deliberate operations of protracted warfare. The heavy tank doctrine saddled the divisional engineers with the mission of erecting pontoon/fixed type bridging not really compatible with mobile operations. For example, the British army⁴⁰ used the divisional Small Box-Girder fixed bridge for light and medium tanks, and the non-divisional Large Box-Girder fixed bridge for infantry heavy tanks to cross gaps up to 130 feet for which floating equipment was unsuited. River gaps greater than 130 feet could be crossed by the divisional Folding Boat floating bridge equipment for light tanks or the non-divisional Pontoon Boat floating bridge equipment for medium and heavy tanks. The fixed bridge sets did not lend themselves to rapid construction and, by 1939, the potentialities of the floating bridges had been stretched to their limits due to the gradual increase in vehicle weights. The result was not entirely satisfactory, since they now could not be used on rivers with fast currents.

This equipment was so bulky and cumbersome in design that it made the heavy-laden two-wheel drive motor transport entirely dependent on the road network. Thus, the only assault bridging available had to be erected in the direct vicinity of prepared

roadways making it a very inflexible and ineffective tool for the support of fast-paced cross-country operations seeking surprise.

The French capability was essentially the same with the exception that sets were furnished as needed from non-divisional parks at the corps and army levels. The French combat engineers also relied on locally fabricated, wooden lattice-girder type fixed bridges for assaults.⁴¹ However, the lack of lateral stiffness, of durability for repeated use, and of ease of transport placed significant limitations of their use in prolonged, rapid operations of maneuver.

In general, Allied bridging sets were too elaborate to lend themselves to mass production which made them unsuitable for employment as an expendable store. Instead, the Allies intended to put down bridges quickly with the divisional or non-divisional equipment and, later, replace them with semi-permanent structures so as to free the original bridge for future use by its owners. However, this system was counter-productive in terms of use in mobile operations in which many gaps may have to be crossed within one day; the divisional engineers required the complete reissue of sets to replace those in service. Once a bridge was emplaced, it would be far more prudent to leave it installed throughout an entire operation or even an entire campaign, for that matter. As it was, the divisional engineers would be forced to wait for the follow-on units to construct a succeeding bridge before they could disassemble their own for use elsewhere. This process obviously posed limitations on mobility, especially for the main battle tank which required the heaviest, and most

erection-time-consuming bridge sets.

Through review of the potential of the divisional engineer one can comprehend the prevailing mentality in the Allied camp. Chivalric values such as bravery and resolution ranked high above any kind of scientific cleverness or expertise in the thrust for victory. Officers planned and conducted operations, extravagant both in time and energy and, thinking only at the pace of non-motorized infantry, could not envision actions of maneuver advancing more than ten or fifteen miles per day, at a time when civilian vehicles easily travelled several hundred miles in that amount of time. The illiberal rationale of the senior and rising officers in a virtually 1918 military organization was unable to correctly assimilate the principles of mechanized warfare. Instead, official doctrines continued to be harnessed to the concepts of an infantry dominated, positional theory of war, a consequence felt by most other countries in Europe, since the French army and, specifically, the French infantry division, the backbone of the army, served as the model during the inter-war period.⁴²

In contrast to the impasse in mechanized warfare development of the Allies was that of the Fascist nations. Though the French and British leaderships had basically maintained a tactical approach to armor employment, ignoring the positions of their unique group of mechanized landpower advocates, the German and, to a certain extent, the Italian regimes had not. The theories of Martel, Fuller, Liddell Hart, and others prescribing the strategic use of armored formations, were greeted with enthusiastic interest by the German and Italian adherents who,

unlike their British prophets, were able to gain the needed visibility to develop the concepts of mechanized warfare 'in toto'. Through the realization of the Panzer Division, le divisioni corazzate, and the Blitzkrieg/la guerra di rapido corso (war of rapid course), the future axis powers picked up the torch and carried mechanization to a more absolute reality and, thus, their combat engineers played a different role.

FOOTNOTES

¹When one considers the fact that war industries at this time produced some 35,000 individual articles of equipment necessary for modern warfare this point becomes understandable, even with expanded general staffs.

²For a good discussion of militarism and its subjugation to civil control, see Alfred Vagts, A History of Militarism. (New York: Meridan, 1959), pp. 232-238.

³See Sir Giffard Martel, An Outspoken Soldier. (London: Sifton Praed & Co., Ltd., 1949), pp. 12-18. and History of the Corps of Royal Engineers, vol. V. (Chatham: The Institution of Royal Engineers, 1952), p. 443-452.

⁴Major-General E.K.G. Sixsmith, British Generalship in the Twentieth Century. (London: Arm and Armor Press, 1970), chapter 6.

⁵Major-General J.F.C. Fuller, Memoirs of an Unconventional Soldier. (London: Ivor Nicholson and Watson Limited, 1936), chapter 13. and Colonel Frank M. Davis, The U.S. Army Engineers -- Fighting Elite. (New York: Franklin Watts, Inc., 1967), pp.107-109.

⁶Brigadier-General B.K. Young. "The Development of Land-Mine Warfare", The Army Quarterly and Defence Journal, 49 (Oct.-Jan. 1944-45):189-199. and Major-General J.F.C. Fuller, Machine Warfare. (Richmond: Garrett and Massie, 1943), p. 200.

⁷History of the Corps of Royal Engineers, vol VII, p. 230. and Martel, pp. 18-30.

⁸As early as November 1916, Lieutenant-Colonel Martel had done much to define mechanized warfare. In a paper "The Tank Army" he suggested the use of fortified strong points for tank bases from which armored units could be supported. He envisioned tank attacks being led by light, fast armored units, followed by slower, heavier more powerful combat groups; combat engineers and signal support units were to accompany the main battle group and also were to be mounted in tanks designed to assist them in accomplishing their respective missions. The tank bases were also supported by engineers who would erect obstacles and emplace minefields for their defence. See Sir Giffard Martel, Our Armoured Forces. (London: Sifton, Praed & Co., Ltd., 1935), appendix H.

FOOTNOTES (Continued)

⁹For details on combat engineer organizations after the War, see Captain W.A.H. Hare, "The Engineer Arm in Continental Armies", Journal of the Royal United Service Institution. XXIX (1885):1159-1196, XXX (1886-87):795-833 and 1183-1227, and Colonel G.H. Addison, "The German Engineer and Pioneer Corps". The Royal Engineer Journal. XLIV (June 1930):241-252 and (Sept. 1930):390-412.

¹⁰For details on the armor employment in the Cambrai operation, see Sixsmith, chapter 6; and B.H. Liddell Hart, The Tanks 1914-1939, vol. I (New York: Frederick A. Praeger Publishers, 1959), Part I "1914-1918".

¹¹See footnote 7, and Field Marshal Lord Carver, The Apostles of Mobility. (New York: Holmes & Meier Publishers, Inc., 1979), pp. 22-24. and Martel, An Outspoken Soldier, chapters II and III.

¹²Fuller, Memoires of an Unconventional Soldier, chapter 13. and Carver, pp.31-33.

¹³For specifics on how Fuller developed his concepts, see Robin Higham, The Military Intellectuals in Britain 1918-1939. (New Brunswick, New Jersey: Rutgers University Press, 1966), chapter V. and Jay Luvaas, The Education of an Army -- British Military Thought 1815-1940. (Chicago: The University of Chicago Press, 1964), chapter 10.

¹⁴J.F.C. Fuller, Armoured Warfare. (London: Eyre and Spottiswoods, 1932 republished 1943), 71-72.

¹⁵Ibid., p. 127.

¹⁶Ibid., especially pp. 20, 26-27, 33, 78, 93-94, 106, 110, 123-125, and 130.

¹⁷Fuller, Machine Warfare, p. 80.

¹⁸For detailed analysis of Liddell Hart's theories, see Higham, The Military Intellectuals in Britain 1918-1939, pp. 82-109., Luvaas, The Education of an Army -- British Military Thought 1815-1940, chapter 11., and Carver, The Apostles of Mobility, pp. 40-54.

¹⁹Captain B.H. Liddell Hart, "The Development of the 'New Model' Army: Suggestions on Progressive but Gradual Mechanization", Army Quarterly, IX (1924), 37-50.

²⁰B.H. Liddell Hart, Thoughts on War. (London: Faber & Faber Limited, 1944), pp. 231, 238, and 241. and The British Way in Warfare. (London: Faber & Faber Limited, 1932), p. 107.

FOOTNOTES (Continued)

²¹Lieutenant-Colonel G. Le Q. Martel, "Mechanization and Divisional Engineers", The Royal Engineer Journal, XLVI (June 1932):643-647. A good comparison of a horse-drawn divisional engineer unit with a mechanized one.

²²Nature of hasty work - the engineers must be prepared to assault breach water obstacles and all of the following hasty defensive works/obstructions, and those of a deliberate nature (see footnote 24). The general rule is first to concentrate the bulk of the engineer force on those things which most increase the defensive strength of the position: a) providing camouflage, limited, generally to selection of positions affording natural cover or ease of concealment, b) clearing reasonable fields of fire for flat trajectory weapons, c) digging open emplacements for machine-guns, d) digging fox holes (small pits for individual soldiers), e) creating obstacles, primarily wire entanglements and minefields to support fortifications; road craters, abatis, and bridge demolitions to support counter-mobility, f) digging shallow trenches connecting fox holes when time permits.

²³Captain C.P. Worsfold, "The Bridge Problem of the British Army", The Royal Engineer Journal, XLIV (March 1930):13-29. Specific strengths and weaknesses can be understood more fully through review of this article.

²⁴Deliberate nature of work - river crossings were supposed to be unopposed, intentional, and somewhat relaxed affairs, as were any other types of breaching operations (with the exception of sieging operations) which were normally reserved for field works as follows: a) providing adequate wire communications, b) providing shelter for those working on position, c) providing camouflage for important installations, d) constructing splinter-proof or shell-proof observation posts, e) constructing protected shelters for troops, command posts, aid stations, etc., f) construction splinterproof or shellproof emplacements of infantry supporting weapons, g) constructing standard fire and communication trenches, h) constructing artillery emplacements, i) constructing obstacles of all types, including anti-tank (dragon-teeth, tank-ditches, tetrahedrons, and standard pattern minefields).

²⁵Martel, An Outspoken Soldier, p. 49.

²⁶Brigadier-General R.J. Collins, "The Armoured Force", The Royal Engineer Journal, XLIII (March 1929):30-32.

²⁷Martel, An Outspoken Soldier, chapter VII.

²⁸Major C.C.S. White, "Tank Stepping-Stones", The Royal Engineer Journal, LI (March 1937):90-95.

FOOTNOTES (Continued)

²⁹K.J. Macksey, Armoured Crusader -- A Biography of Major-General Sir Percy Hobart. (London: Hutchinson & Co., 1967), pp. 131-132.

³⁰See the following for the specifics on French military decadence after World War I: Adolphe Goutard, The Battle of France. (London: Frederick Muller, Ltd., 1958), p.19., Ian Hogg, The History of Fortification. (London: Orbis Publishing, 1981), pp. 208-209., and Andrew Mollo, The Armed Forces of World War II. (New York: Crown Publishers, Inc., 1981), pp. 48-49.

³¹Richard Holmes, Bir Hakim -- Desert Citadel. (New York: Ballantine Books, Inc., 1971), pp. 16-17.

³²Ibid., p. 17.

³³For detailed explanation of the Allied inadequacies in 1939-40, see Goutard, pp. 30-32. and Sixsmith, chapter 9.

³⁴Brigadier-General Peter Young & Brigadier-General James L. Collins, Jr., Eds., The Marshall Cavendish Encyclopedia of World War II, vol 2. (London: Orbis Publishing Limited, 1972), "The Armoured Balance 1940", p. 176.

³⁵Brigadier-General G.E.H. Sim, "The Employment of Divisional Engineers in Conjunction with other Arms in War", The Royal Engineer Journal, XXXVI (Dec. 1922), reprinted LIV (March 1940):36-46.

³⁶Through comparison of German and Allied engineer management, one can understand the need for combining and prioritizing engineer capabilities with other arms. The Allied withdrawal in 1940 provides the proof. See History of the Corps of Royal Engineers, vol VIII, pp.28-37. and Major M.L. Crosthwait, "Demolitions and Minelaying - Some German Methods", The Royal Engineer Journal, LXVI (June 1952):171-179. and "Tanks and the Fall of France", Infantry Journal, (Feb. 1941).

³⁷A long and very detailed working-out of an imaginary action by a corps of two divisions was presented in this article as late as 1937, sequentially explaining the use of artillery in clearing obstacles. Colonel Mainie, "L'attaque avec engins blindes d'une position sommairement organisee", Revue Militaire Generale, (Feb. 1937). Until the Germans formed tank units after 1936, anti-tank defence played a very subordinate role in French official regulations, Vierteljahreshefte fuer Pioniere, "Panzernahabwehr aus franzoesischer Sicht", (May 1937); see also Reglement sur la manoeuvre et l'emploi du genie, part II, and the Manuel du grade du genie, (1934).

FOOTNOTES (Continued)

³⁸Major-General L.V. Bond defines the incompatibility of the divisional engineer with mechanized warfare, as late as 1938, in his article "The Military Engineer in Modern Warfare", The Royal Engineer Journal, LII (Dec. 1938):518-529. The following articles from The Royal Engineer Journal also reveal how training was almost completely oriented towards static fieldworks, bridge erection, and maintenance of road communications; with the exception of bridge demolition, no other types of barrier tactics or anti-mechanized defence were practiced. A situation that did not change prior to 1939: Major C. De L. Gaussen, "Training in the Field Company", XLV (Sept. 1931):502-508., Lieutenant-Colonel L.V. Bond, "Standard Tests of Fieldworks Training", XLV (Sept. 1931):469-474.; Captain E.H.T. Gayer, "Annual Training of Field Companies of Divisional Engineers", XLVI (Sept. 1932):491-501; Major W.W. Boggs, Rapid Road Catering, LII (June 1938):247-257.

³⁹The Marshall Cavendish Encyclopedia of World War II, vol 2, p. 204. The author says that minesweeping is not practical. Colonel Mainie, "L'offensive et la defensive avec les engins blindes", Revue Militaire Generale, (Feb. 1937). Captain Koller-Kraus, "Neuzeitliche Gliederung und Ausstattung der englischen Divisionspioniere" Vierteljahreshefte fuer Pioniere, (May 1939)., Brigadier-General B.K. Young, pp. 189-190., and Major-General R.P. Pakenham-Walsh, History of the Corps of Royal Engineers, vol. VIII. (Chatham: The Institution of Royal Engineers, 1958), chapter 11.

⁴⁰For particulars on the state of the art in British assault bridge design and potential at the advent of World War II, see: History of the Corps of Royal Engineers, vol. VII, pp. 176-179., vol. VIII, pp. 186-188., Major W.H. Aylwin, "Divisional R.E. Units Equipment on Active Service -- The Divisional Field Park Company", The Royal Engineer Journal, LX (June 1941):187-189.

⁴¹Lieutenant-Colonel Guet, "L'utilisation des poutres a treilles en bois", Revue du Genie Militaire, (July- Aug. 1937).

⁴²Mollo, "The War in Europe 1939-40", pp. 1-80. quoted from p. 40.

CHAPTER III

The Divisional Engineers and the Development of Blitzkrieg Warfare in the Axis Camp from 1935 to 1940

As a result of the conversion of Germany and Italy to Fascism, these countries were able to develop their armored forces as offensive strategic weapons, according to the theories of mechanized landpower, even though Italy was less successful than her counterpart. These formations were based on combined-arms principles, which fully incorporated the mobility and counter-mobility function of the combat engineer to enhance unit combat potential on the dynamic battlefield. By means of the Blitzkrieg formula, the German combined-arms mechanized forces overwhelmed the traditionally oriented armies of the Allies during the first three years of World War II.

The Fascist State -- The Patron of Mechanization

Some of the greatest catastrophes in military history can be attributed to the planning of future warfare based on the outcome of past conflicts. Effective features of past campaigns become stratagems, regardless of contemporary capabilities, methods, and techniques for the improvement of combat readiness. Convinced that they have developed the recipe of victory, military leaders allow themselves to be defeated by opponents, who employ more modern weapons and techniques. As the winning forces, suffering from this "victor's syndrome", are lulled into a false sense of security, those of the vanquished or challenger are encouraged to develop a new formula for victory. Thus, the evolution of

warfare advances. Within this process, the development of mechanized warfare in the form of the Blitzkrieg probably exercised the greatest influence on warfare, since the massed cavalry formations of the Mongol hordes.

Germany and Italy, had accomplished very little in the way of mechanization during World War I, possessing only a handful of tanks most of which were captured from enemy or imported from allied nations. This contrasted greatly with the French and British who, at the time of the Armistice, were encumbered with huge numbers of these quasi-obsolescent war-machines and a "first draft" doctrine for their employment, which never reached consummation due to the War's early end in 1918 instead of 1919. With their budgets tied up for several years supporting their substantial tank investment, then overlapping into the 1920's after which few governments could afford to finance large-scale production*, these nations easily succumbed the victor's syndrome. All preceding mechanized development was unwittingly directed into fixed channels by the existence of these outmoded armored formations or this predetermined tactical and strategic role.¹ Both Axis nations, on the other hand, had the opportunity to conduct extensive research and development with the most up-to-date armored vehicles before investing in major tank construction programs,² especially after the late 1920's, when competent light and medium tank designs began to appear on the market in significant numbers.

*The British and French armies' use of light and medium tanks in 1940 which were developed in the mid-1920's also lends credence to the victor's syndrome theory.

As stated, both France and Britain had been compelled to introduce armored vehicles before they had developed a doctrine for their most advantageous, practical use. Here again, Italy and Germany had benefited as late-comers in mechanization, since both tended to develop their basic principles for strategical and tactical armored employment before they augmented these plans with compatible armored formations and tank designs. This process was favored by the fact that it progressed with consideration of the mechanized landpower theories through experimentation during large-scale-unit maneuvers, and with the practical experience gained in the limited warfare and military operations of the 1930's.

In comparing the evolution of mechanization in the Allied to that of the Axis camp, one might simply say: "Old weapons make old tactics and new weapons make new tactics." In the democratic nations military development continued uninterrupted by internal upheaval or radical political reformation. Consequently, a tremendous rigidity and adherence to old systems and requirements for war persisted. However, there was a revolutionary force at work within the totalitarian nations, best termed a youthful, spiritual force. The influence of Fascism³ with its philosophy of the corporate state had generated a fervent will to move forward, by releasing the energetic forces possessed by their ethnocentric-communities and by directing them towards an aggressive nationalism. The Germans reflected with vengeance on World War I, due to the Treaty of Versailles (1919), the Italians with a certain contempt, due to the Treaty of London (1915), in which the Italians had been promised excessive territorial

aquisitions in the Alps and along the Adria by the Allies to bring them into the war effort; a pledge which the final peace settlement did not honor completely. These social and political relationships helped to inject this new socio-dynamic vitality with a militaristic mentality, especially by the mid-1930's, with the advent of Naziism in Germany and with Fascist Italy's attempts to capitalize on the prevailing uncertainties of the European situation.

The most fundamental question to be answered when embarking on the process of mechanization was the determination of whether armored vehicles would be employed as tactical or strategical weapons. If tank formations were be merely tactical aids they could, as in the case of the Allied armies, easily be assimilated into existing military formations. When employed as independent strategical forces, on the other hand, a sophisticated transition would be necessary throughout the entire armed forces. Once the role of the tank was ascertained, more operational questions could be resolved. First, to what branch the armored forces would belong, second, what quantities, qualities, and types of vehicles would be required of armored formations for the functions assigned to them. As will be seen, the Fascist solution was to contrast greatly with that selected by the other governments of Europe.

The tank was a unique piece of equipment because it was compatible with all three of the traditional branches. When considering its ordnance alone, this armored vehicle could have been integrated most easily into the artillery, since it could

engage the enemy with indirect fire at a considerable range. When considering its armored protection, it was be more effective when used with the infantry as an anti-machine-gun device. Finally and most significant of all, due to its mobility, which could outpace by far the speed of unmounted troops, it was also well suited to function as a cavalry scout or screen vehicle. The Allies, thinking in terms of trench warfare, had adopted all three of these assets and, as a result, limited the tank to a subordinate tactical role. The Fascist states, however, eventually moved beyond this three-dimensional concept of tank employment. They were thinking in terms of eliminating the use of trenches altogether and, accordingly, adopted a fourth dimension, an independent tank formation capable of delivering the decisive, dynamic offensive blow. Basically, they tailored their mechanized forces to provide the army with such a strategic weapon by consolidating their tanks in divisions which were autonomous in combat of the three traditional branches. Armored units were then given the opportunity to mature and improve their unique capabilities without the usual interference from the non-tank officers of the traditional branches who, in the past, had commanded the tank units as well.

For the tank to function as a strategic weapon, it had to be fast, durable, and accurate. Armor protection and the ability to engage anti-personnel weapons were secondary considerations. Thus, the tank needed to be armed with a precise, armor-piercing main gun, instead of a loose-fire anti-personnel blasting weapon; tanks fighting independently would engage logistical transport or tanks in reserve, rather than fortified troops. In addition,

armored vehicles needed to be light to cross temporary bridges available at the divisional level and primary and secondary road bridges. Consequently, the Fascist nations eventually adopted the most suitable design for the main battle tank, the medium class armored vehicle with a high-velocity anti-tank gun.

A tank formation, however cannot function in the strategic mode without being self-sustaining. Once the armored division is committed as an independent striking force, it cannot operate for long, unless organic combat support and service support elements are attached permanently and are logistically self-supporting. These units also have to be equipped with armored cross-country transport and provided with weaponry (i.e. machine and anti-tank guns) allowing for their survival within the combat zone and behind enemy lines when assisting combat maneuver units during deep penetrations. This requirement contributed to the independence of tank units from the traditional branches and served to elevate the status of armored formations. Thus, in order to develop mechanization as a process enhancing strategic designs, the Fascist nations channeled it towards independent armored organizations representing a more or less separate branch of service. By doing so, they were able to develop tank organizations to their fullest potential and then incorporate the dynamics of such a perforating force with the rest of the army.

As Liddell Hart had anticipated, it was the armored force's great potential as a combined arms team that enabled it to succeed. Such synthesized organizations, however, require leaders and troops devoid of regimental, branch, or social class

bias. Loyalty had to be directed to the accomplishment of the team goal, other considerations being only of secondary importance. In assimilating this type of attitude, the Fascist mentality was far better predisposed than that of the democratic society. The Fascist ideology replaced social prejudice with racism. In the corporate state, nobility of birth belonged to all members of an ethnic group, forming an "aristocracy of the masses". Military service was not a profession, it was a part of daily life of the armed society.⁴ Militaristic education of the youth began early in childhood and such para-military organizations as the Hitler Youth in Germany and Young Wolves or Balilla in Italy indoctrinated future leaders or members of society with a sense of partnership in allegiance to the state. This perspective was further instilled in the adult through service in the SA (Sturmabteilung) or the SS (Schutzstaffel), and the Black Shirts (Fasci di Combattimento) or the Sabato Fascista. Through this social militarism, the rationale of generations of Germans and Italians were programed, although inadvertently, with the corporate spirit so vital in combined-arms operations, and could not help but to promote and to accomodate such functioning within the new armored formations as they were developed.

In addition, the mechanization of warfare required new leadership characteristics. Even in the strategical mode, the campaign would be crucially influenced at the tactical level of combat where, due to the great variety of possibilities, the course of battle could not be forecaste. This demanded flexibility of mind, eager acceptance of responsibility, a combination of caution and audacity of the small unit leader and,

above all else, the confidence and respect of the fighting troops under his control. The Fascist, militaristic educational system produced this type of leader 'en masse' for the first time. Scientific soldiership replaced the traditional aversion of officers to learning. Education had made a 180 degree turn and now was subjugated to the army in order to enhance the military preparedness of the nation. As Mussolini himself proclaimed: "Military training forms generations which obey, not because they are ordered but that fight because it is their desire." This social militarism slowly helped to make the armed forces nothing more than a pure instrument of the state executive, at the complete expense of the old military elite.

As the transition was made from an army of a professional elite to an armed society, the dictators who controlled the money strings began playing an absolute part in war planning. Eventually, both Hitler and Mussolini eagerly interfered in the management of the armed forces and were just as keen at securing the most up-to-date weapons and at applying modern concepts. Unfortunately for them, the persistent Fascist anti-intellectualism of their regimes hampered the most efficient research of development of these factors. If the planning and production of modern war machines had been a little more proficient, the Axis would have been much further ahead in mechanization than they were at the beginning of the War.

Nevertheless, the affinity of the Fascist nations for mechanization was fundamental to the development of independent armored formations and to the concept of the Blitzkrieg type

campaign. Mechanized warfare, by the latter 1930's, was being fitted like a gauntlet on the fist of Fascism. It was to deliver the armored punch which, when directed at the vitals of an enemy, was intended to administer the death blow.

Italian Development of Strategic Mechanized Warfare --

La Guerradi Rapido Corso

Initially, as in the other armed forces in Europe, modernization and mechanization within the Italian army faced the resistance and age-old prejudice of the officer elites who had clung fast to the methodology of traditional strategy and tactics.⁵ This conservatism was based on defensive warfare and the axiom that the infantry was the fundamental constituent of the army. However, circumstances of a quite different nature from those experienced by the other European powers led to this perception.

Since Italy historically had been the battleground of foreign armies competing for its control, strategy habitually overemphasized defense against such invasions. Due to its topographical location with the country almost completely protected by mountains on the mainland (and to the lack of finances which had plagued the young nation since its inception in 1870), the army was organized for alpine defence along the traditional avenues of penetration. The Alpini (mountain troops) and the Bergsaglieri (light infantry -- sharpshooters) dominated the army and because of their distinguished past, these branches eventually were viewed as the military elite.⁶ Although the cavalry, with no less prestige, normally was used in conjunction with these infantry formation to block any successful enemy

penetration, the lack of open terrain limited them in reality to a strategic reserve function.

The First World War did not alter this concept. In fact, it seemed to strengthen the Italian belief in the infantry/cavalry combination, especially after the victory of Vittorio Veneto.⁷ During this offensive, the Austro-Hungarian army evaporated, more due to the collapse of the Hapsburg monarchy than to Italian military prowess, and was forced into total rout. The cavalry was used extensively in the offensive pursuit, victoriously capturing Trento, Trieste, and many other cities as the advance continued, while facing little opposition. As a result, the vulnerability of the cavalry was obscured, and the Italian General Staff remained convinced of its offensive potential throughout most of the inter-war years. The prevalence of this attitude proved to be beneficial during the development of Italian mechanization, however, since the tank, as an aid to cavalry operations, was considered seriously in terms of a strategic offensive weapon. The armored vehicle could reach its full potential only when employed to support offensive warfare, a stratagem which the Italian General Staff eventually realized.

Unfortunately, years passed until this manifestation gained acceptance, and throughout the 1920's and early 1930's the tank continued to be programmed as an infantry assault support vehicle. As with the cavalry, the lack of good terrain on the defended frontiers restricted the feasibility of using armored formations other than as a strategic reserve. Therefore, during this period, the few tanks available were organized in company or battalion size support units designed to reinforce infantry

formations in their attack of fixed positions.⁸ Due to the restrictions placed on tank design by the mountainous terrain, the Italians produced only light tanks armed with machine guns, which were suited best for narrow roads and steep inclines. During the 1920's, only 125 of these tanks were produced, demonstrating that the tank had been firmly established within the army, but that the temporizing financial commitment still had left great latitude for future development.

By the mid-1930's, this situation began to change rapidly. The fascist regime increased its efforts to infuse the Italian people with a bellicose, martial spirit while, at the same time, inaugurating an aggressive and imperialistic foreign policy. As Italy prepared for war, the Army General Staff, in part due to the spread of Fascist influence within the military forces, commenced with the development of a stratagem, which stressed the primacy of offensive, in accordance with the nation's new found ambition.⁹ Initially, the army experimented with a new kind of maneuver force consisting of cavalry and Bersaglieri mounted in armored machinegun carriers (CV 33) or on bicycles. In this way, for the first time, tanks were incorporated as a part of a maneuver force. These preliminary research efforts resulted in the authorization of a program according to which one tank squadron was to be created within each cavalry regiment, and one battalion to be assigned to each infantry corps.¹⁰ At this point, a consequential step had been made in the direction of mechanization, since the creation of of a large number of armored formations and the production of thousands of modern light tanks

now gave the General Staff the opportunity to incorporate these new units into large-scale maneuvers.

The combat experience gained during the invasion of Ethiopia and in the Spanish Civil War also was of significant importance in the development of the Italian armored arm.¹¹ In these conflicts, during the period from 1935 to 1937, the Fascist regime over-publicized the use of armored vehicles in the hope of impressing the world with Italian combat readiness and military prowess. This did much to cause the Italian General Staff to contemplate more appropriate roles for armored formations, especially since the tank generated such great interest and, if properly employed had the potential of earning significant respect for the Italian army in general. In addition, the development of the medium tank with a turret mounted machinegun and a fixed cannon (anti-tank gun) was initiated after several incidents had demonstrated that the standard Italian tanks with fixed machine-guns could easily be outflanked, and lacked the heavy weaponry to engage enemy positions and vehicles effectively. These events, together with further experimentation in 1937, precipitated the final creation of independent armored divisions and a strategic doctrine for their use. At the same time, the victory in Ethiopia welded the army and the Fascist regime together and brought both under the absolute control of Mussolini, thus generating the needed motivation to allow the mechanization to continue.¹²

War experience also had proved the need for greater motorization within the army. This resulted in an acceleration of the motorization program and, at the same time, benefited the

development of mechanization. On 1 June 1936, the Italian army temporarily formed a motor-mechanized brigade which, on 15 July 1937, was reorganized as the Prima Brigata Corazzata (First Armored Brigade), consisting of one tank regiment, one motorized Bersaglieri regiment, one engineer and one anti-tank company, and one anti-aircraft battery. During the annual grand maneuvers of 1937, the brigade was used as "an instrument of high penetrating capacity, designed to open a breach in a solid enemy line".¹³ Lessons learned during this exercise served as a basis for the final development of armored forces in the Italian army. After-action-reports and official military journal articles recommended the use of tanks 'en masse' and in independent roles, and emphasized the potential of the armored formations.¹⁴ From these suggestions and the practical knowledge gained, the General Staff under the persistence of Mussolini began to form armored divisions (le Divisione Corazzale Arieto and le Divisione Corazzale Centauro) and had established doctrines using B.H. Liddell Hart's strategy, the "expanding torrent", for mechanized warfare, appropriately labeled "War of Rapid Flow" (la Guerra di Rapido Corso).¹⁵

The armored divisions were planned as combined arms teams. The mass combat power of the tank regiment was to be embodied in the four medium-tank battalions, one battalion of heavy tanks which was included for use against strong-points, and one light battalion for reconnaissance. The division also boasted a Bersaglieri regiment of two battalions mounted in trucks, one company of motorcycles, an artillery regiment, an anti-tank

company, two batteries of anti-aircraft guns, and a combat engineer company.¹⁶ All wheel-drive military trucks in production, notably the Fiat Dovunque (Anywhere), were programmed as the motor transport. Simultaneously with the creation of this new armored division, a new manual, Impiego delle Unità Carriste was published, which outlined the new concept of mechanized warfare. This manual differentiated between the tasks of infantry-support tank units and those of the independent armored division, a maneuver force to be used against the enemy flank or for penetration and deep exploitation of his line.¹⁷ The general concepts of the mechanized landpower advocates were incorporated to a remarkable degree, with the paralysis of the enemy command structure as the ultimate aim.

Unfortunately, Italy's productive potential was far behind its military planning. The inadequately managed mass-productive capability of the nation was incompatible with mechanized warfare, since Italy lacked the natural resources, the funding, and the technological expertise to compete with other industrialized nations.¹⁸ As a result, the medium-tank battalion of the new armored forces, of which in addition to the equivalent of five motorized divisions only three eventually were equipped and sustained, entered the Second World War with machinegun armed light tanks which were seven to twenty years old. It should be

*This can be compared to the other industrial nations who, during the course of the War were able to establish and continually maintain the following divisions: United States - 16 armored and 43 motorized/mechanized infantry; Britain - 4 armored and 8 motorized/mechanized infantry; Germany (including satellite states under occupation) - [in various states of readiness] 30 armored and 25 motorized/mechanized infantry.

remembered that this tank was developed for use in the Alps as well as in open terrain. These armored vehicles were only partially replaced just prior and during the first year of the War, with either the 1936-38 model cannon armed M11/39 medium tank* or the L6/40 light tank; both pieces of equipment were obsolete before their introduction to combat. The year 1939 set in motion a rapid acceleration in tank technology, and production, research, and development progressively improved and enhanced the capability of new armored vehicles. Nevertheless, from this point, throughout the duration of War, Italy was increasingly left behind in tank development, her efforts producing only a trickle of outdated tanks. The anti-tank gun and artillery capability also was weak, with most units under-equipped with antiquated weaponry. Although the infantry and combat support troops eventually were mounted in cross-country vehicles, they lacked armored protection and thus could easily be separated from the tank formations during combat, causing the combined-arms team to break down. Consequently, the Italian armored forces were not prepared to deal offensively with a tank-versus-tank environment. Therefore, the artillery or the anti-

*One can see the influence of the concept of tank employment on tank design in all armored formations up to 1938, and after in the infantry-support tank. The M11/39 had a fixed cannon mounted in the hull, allowing it to fire only to the front, while the machinegun was mounted in the turret. This is a prime example of the infantry-support vehicle. The main gun was designed to blast field fortifications during the assault, while the machinegun could be traversed to engage troops as the enemy position was overrun. In the case of using the armored vehicle as an anti-tank weapon, the cannon had to be mounted in the turret. This problem was finally resolved when the Italians introduced L6/40 light tanks in 1940, and the M13/40 medium tank in 1941. These tanks had the main armament mounted in their turrets.

tank gun remained their only viable anti-tank weapon throughout the War. Although the spirit of mechanization was present, the physical ability to make it become reality was not. But even motorization fell far behind expectations and, like in most other European powers, horse-drawn transport remained the primary means of conveyance for the army.

The Italian Army General Staff further compounded these problems when in the late 1930's, in an attempt to save money and to allow the career officer better possibilities for promotion, an army-wide policy was established which filled the majority of company grade officer and enlisted positions with reservists. Consequently, the leadership at the combat unit level was undermined.¹⁹ In the new armored divisions, little constructive combined arms training could be accomplished and, when the War started in 1940, the mechanized units had scarcely been familiarized with this new mode of warfare. Furthermore, the Italian army never had the opportunity to practice coordination and interoperability between mechanized, motorized, and non-motorized elements above division level. If they had had the chance to test the new concept against a non-mechanized opponent, such as Germany had in Poland, many of the operational deficiencies experienced in the early campaigns of World War II could have been corrected previously.

As things turned out, Italy was not offered such an advantageous trial-and-error conflict, and her general poor performance in the mechanized warfare of 1940 resulted. The army was not given enough time to make the transition from a static 1918 military organization to the more mobile establishment

required for warfare of dynamic maneuver. Although the Italian army had moved ahead of the other major powers of Europe, with the exception of Germany, and now had the armored, independent striking force to put into practice the concepts of the mechanized landpower advocates, the armored forces alone were being indoctrinated for mechanized warfare. In Italy, the infantry-support tank battalions were all grouped under a separate administrative headquarters, and segregated from daily contact and training with the divisions which they would join during the War. Only in Libya were the infantry-support tank battalions organically attached to their parent infantry division and corps commands. But even there, they were used in their traditional role during exercises, i.e. assigned piecemeal as infantry assault vehicles.²⁰

The primary reason for the non-mechanized units in the army being not incorporated into the grand designs for campaigns of maneuver were as follows. First, even though the doctrine had changed, the equipment had not. The infantry divisions were primarily dependent on horse-drawn transport and weakly provisioned in anti-tank weaponry, and thus could hardly support mobile armored operations, even in a limited manner. Second, the higher commanders, except those in the motorized/mechanized forces, had not yet been convinced, in either the practical or the conceptual sense, of the potential of mechanized warfare. Before the Army General Staff could begin to resolve these dilemmas, the War was upon them; Galeazzo Ciano, Italy's Foreign Affairs Minister (1936-43), himself believed that Mussolini

should not have formed an alliance with Germany until 1943, due to the army's lack of readiness.²¹ Consequently, the Italian army was hampered by a bi-conceptual view of warfare throughout most of the conflict. Italy needed its own version of Germany's General Guderian, a mechanized warfare systems architect who could have welded the two divergent perceptions into a coherently dynamic plan of operations while, at the same time, instilling the military organization with an aggressive spirit; a mechanized specialist with the ability to organize progressive programs of equipment development, unit training, and logistics efficiency throughout the armored/mobile forces, and then to incorporate this effort as the offensive spearhead within the army. Unfortunately for Italy, such a leader never materialized. The Italian soldier did not lack bravery; but the mediocre leadership and substandard arms and equipment in the Italian army robbed him of both the confidence and the ability to wage mechanized war. Thus, the true potential of the Italian armored forces was never realized, which had a significant impact on the preparedness of the Italian combat engineer to support mechanized warfare. Nevertheless, important advances in the techniques and methods for supporting mobility and counter-mobility on the modern battlefield were made.

The Readiness for Mechanized Warfare of the Italian Combat Engineer

One of the Italian army's primary functions was to provide for the defence of the natural Alpine frontier. This mission was of fundamental importance to the divisional engineer units, since

mountain warfare was conducive to small-unit action. Throughout the inter-war years, hasty methods for defensive, delaying, and blocking operations as well as assault actions to support this task were effectively developed by the Italian Corps of Engineers. These were to be accomplished by small, independent combat engineer units in conjunction with semi-autonomous Alpine, Bersaglieri, or mountain infantry regimental battalion, or company combined-arms groups (Raggruppamenti).²² Consequently, the Italian combat engineer not only experienced sufficient training in hasty operations but also got significant indoctrination to cooperate extemporaneously with front-line and maneuver troops on limited operations in a direct support role. Although the employment of combat engineers in this manner was an essential requirement in mountainous terrain, this perspective of engineer utilization was slowly established throughout the army as it was greatly expanded in the 1930's, especially after 1935, when the armed forces officially adopted the Fascist military doctrine, stressing the primacy of the offensive.

The importance of these principles also lay in their easy application to mechanized operations. Accordingly, this process started as early as 1935, when the Italian army seriously began to consider mobile armored/motorized operations.²³ In order to support the mobility of friendly maneuvering forces, the engineers quickly realized the importance of mechanizing and motorizing divisional engineer support units. As in the Allied nations, however, the function of the infantry-support tank units infringed on the combat engineer mission, but not nearly to the same extent as in these other armies. Up to the 1939-1940

period, the Italian tanks were thinly armored machine-gun carriers, far inferior in fire power and armored breaching/demolishing might to the heavy infantry tanks of the French and British armies. Thus, the Italian infantry formations depended, to a considerable degree, on the engineers during assault operations, for mobility in the crossing of entanglements, tank ditches, or water obstacles, and for assistance in the storming of fortified positions. To accomplish these tasks, the combat engineers were equipped with flamethrowers, bangalore torpedos, barbed wire cutters, and demolition materials and equipment;²⁴ in the infantry tank units, some tanks were modified and fitted with flamethrowers.²⁵ This cooperation resulted in only partially motorized, and never mechanized divisional engineer units.

Due to the lightness of Italian tanks, with the heaviest weighing only eleven tons, the bridge equipment designs developed and used in World War I were easily modified and refitted for use by the mechanized and motorized forces during the inter-war years. Even though this equipment, used similarly to that of the Allied armies, was not perfectly suited for dynamic, mobile operations, it caused the development of the ability to accomplish rapid water and dry gap crossings as a primary consideration of the Italian army's armored corps (Corpo d'Armata Corrazzato). This unit was located and conducted maneuvers in the Po River valley, and remained the only real mechanized force. This organization had reached only 80 percent strength in men and equipment by April 1939,²⁶ however, and this, together with the

lagging industrial and technological progress, prevented the improvement of bridging equipment and methods before the War. The rest of the army did not experience these kinds of problems to the same extent, since its areas of operation were located either in mountainous or desert regions, where the rapid spanning of water obstacles was far less important, it generally was not motorized, and it was prepared to wage a positional type of warfare rather than one of maneuver. Consequently, bridging assets and equipment continued to be held at the non-divisional level,²⁷ and to be issued only, as in the French army, from higher headquarters as an expendable item of equipment, a practice which limited the mobile independence of the mechanized/motorized division.

Counter-mobility and defensive operations also were considered fundamental elements of modern warfare, and it was in this area that the Italian combat engineers made their greatest contribution. The reason for this fact lay in the great importance of these capabilities in both static and mobile operations, no matter where conducted, even though in the case of the Italian army, they were tailored for mountainous or lower-plains areas of Northern Italy. The Corps of Engineers eventually realized that obstacles of the type used in former wars no longer served the purpose of delaying or blocking modern mechanized or motorized armies. Obstacles had to be placed in depth, emplaced rapidly, and as effortless as possible in regard to combat engineer services.²⁸

Efficient methods and procedures evolved mainly due to the excellent practical training localities for counter-mobility

obstacles provided by the mountain regions of Northern Italy. To impede the enemy, tunnels bridges and road craters were to be blown with demolitions or, if necessary, with landmines, to sever rail and roadways. These obstructions were to be coordinated by the High Command, and emplaced by the combat engineers. Their detonation was left to judgment of the executing officer on location, normally, the leader of the forces provided direct anti-personnel and anti-tank cover-fire.²⁹ The main difference between these procedures and those of the past was the fact that obstacles were now produced in greater quantities and were much more effective, and, thus, more difficult to repair or breach, even with modern machinery and equipment. Furthermore, the demolition of navigable canals and dams were considered, when, there was little time to build obstacles.

The Italian counter-mobility capability was further supplemented, when, as a result of experiences in the Spanish Civil War, the General Staff placed a high priority on anti-tank defence. With the expansion of armored forces in most European armies, including their own, the Italian army now searched for methods to supplement their weakness in anti-tank weaponry. This need was mainly covered through the anti-tank mine which, although not extensively used, had proved its value in Spain.³⁰ By 1938, the Italian combat engineers had adopted mine warfare as one of their principal duties. Platoons designated for this task carried 714 tripmines (anti-personnel)* and 64 pressuremines

*Tripmines were intended for use against men and animals. They weighed four pounds and normally were (continued on next page)

(anti-tank)** , enough to emplace a one kilometer anti-personnel and a 120 meter anti-tank minefield, or a combination of both.³¹ Through training, the combat engineer platoon could put down the entire supply in ten to twelve hours, while providing their own security. They then prepared sketches which pin-pointed the location of each individual mine and submitted them to the divisional engineer company commander (normally only one was assigned to each division) for coordination throughout the division or for further use in recovering the mines.

Procedures for taking up mines were limited to manual techniques. However, tank rollers were under consideration just before the War.³² These were heavy steel rollers, attached to the front and pushed ahead of a tank at a distance of about ten meters, detonated the mines through their own weight. Tripmines offered no special difficulty, since, when they were not used in conjunction with anti-tank mines, they could easily be cleared with aid of a tank or by hand. The anti-tank mines, however, did present a significant problem, since they had to be manually located and cleared, or destroyed by artillery fire.³³ For this reason, the Italians were doctrinally prudent in providing not too much concealment for these devices. In addition, their anti-

*(continued) fixed to the pickets or shrubs at a height of eight to twelve inches from the ground, and then concealed. A pull on the cord to which they were attached released a striker which fired the mine.

**Pressuremines were employed for blocking roads or places likely to be crossed by vehicles or tanks. They normally were arranged so that at least one wheel or track of the vehicle had to pass over at least one mine. A minimum pressure of 250 pounds caused detonation. The mines were buried in the ground and covered with one to one-and-onehalf inches of earth.

tank mines had been developed for use primarily against light tanks similar to their own, and proved to be less effective against well armored medium and heavy armored vehicles. Mine warfare did, nevertheless, provide the Italian army with an effective anti-tank capability, which all the other European powers, except Germany, had failed to develop both doctrinally and in practice. Just before the War, the Italian combat engineers emplaced thousands of landmines to improve the defence of Tobruk and Bardia, Italy's major Libyan ports. This presented, together with the covering fire of the interlocking systems of anti-tank gun/machine-gun positions and the anti-tank ditching, a formidable obstacle, even in terrain with almost no natural obstructions.³⁴

However, the combat engineer forces and their command and control structure had not been organized and systematized adequately to meet the demands of mechanized warfare. Thus, these advances in counter-mobility could not be employed effectively. From its highest levels down, combat engineer management was inhibited by the complex planning and operational regimen indicative of the Italian staff section, still functioning as the central agency for static military activities. As with the French and British commands, it was difficult to get a concerted and coordinated effort behind combat engineer activities. Late in 1942, Major Sillavengo, commander of the 31st Combat Sapper Battalion [Italian], despairingly described the Italian organization for directing the affairs of engineers as a chain of managerial control that originated in the Commando Supremo (Italian Army, Libya) and passed through the troop

command, the supply command, two group commands, three corps commands, and nine divisional commands; 17 commands all together, with five generals, eleven colonels, and at least 40 lieutenant-colonels and majors.³⁵

Obviously, an independent engineer central headquarters was needed, with the command influence and authority to coordinate, manage and supervise engineer activities from the army or corps through to the divisional command structure. In this way, engineer support at each level of control could have been easily integrated and correlated in the overall scheme of the maneuver, through each phase of an operation. Such a level of combat engineer efficiency, however, was never reached. Instead, assigned combat engineer units were responsible for providing liason elements to the units they supported, whether at the army, corps, or divisional level, and had to compete with the more influential arms (infantry, cavalry, and artillery) for staff support and operational visibility. Since the effectiveness of engineer activities normally necessitated both the assistance and sacrifice of these dominating combat arms, it was only on rare occasions that counter-mobility or defence enhancement operations could get the comprehensive, concerted subsidization they required. Of greater consequence, however, was the fact that these liason sections for the divisional staff were not allotted in the standard authorization of personnel and equipment. Thus, the field commanders of divisional engineer units had to try to perform the dual role of staff officer and, depending on the size of the engineer unit assigned, company or battalion commander.

This situation resulted in the engineer effort being under-represented and neglected, when it should have been considered a fundamental element of divisional operations.

These problems were further complicated by an insufficient divisional engineer organization. Those combat engineer units supporting divisions were "mixed", i.e. normally consisted of telegraph and radio-telephone elements.³⁶ In contrast with other armed forces, a separate Italian signal corps had not been formed during the inter-war years so that these duties remained combat engineer responsibilities. Thus, while the energies of the divisional engineer could have been best utilized on the front lines, half of the unit's efforts were diverted to laying telephone wire or maintaining communications in the division's rear. Even worse, the normal accompaniment of combat engineers in the division was a mixed battalion with one company of each in the infantry division, or a mixed company with two or three platoons of each in the mechanized and motorized divisions. This was far from adequate, especially when considering that most armies had at least three unmixed companies of combat engineers per division and, in most cases, even this number did not suffice. In actuality, static, offensive war would have greatly strained these organizations and they could not even have come close to effectively supporting the division in a conflict based on rapid maneuver.

All these aspects of the combat engineer ability to support divisions in the field reflect the readiness of the Italian army for mechanized warfare. In contrast to the Allied armies, the Italian divisional engineer units had been incorporated into the

operations of combat units and functioned in a direct-support mode. In addition, combat engineers were indoctrinated to act in conjunction with these supported units in a combined-arms manner by providing engineer assistance of a hasty nature, although this encounter-limited predisposition favored counter-mobility (i.e. anti-tank, delaying, or blocking actions) due to the character of the army in general. The Italian divisional engineer potentiality resembled that of its Allied counterpart in that it too lacked the armored cross-country vehicles and weaponry which would have allowed for effective cooperation with combat units when in contact with the enemy. This held especially true for the mechanized/motorized units, whose mobility would have suffered considerably, since the engineers could not move rapidly into those areas with enemy integrated or covered obstacles with defensive positions. The methods and equipment for bridging obstacles likewise were unsuited for mechanized operations, hampered by most of the limitations and deficiencies which handicapped Allied rapid maneuverability. Furthermore, the programming and management of combat engineer activities could not be effectively synthesized into the overall operations of the division, due to the lack of an assertive "Engineer Command" structure. This resulted in a staff system which lacked the cognizance and proficiency to rapidly, and most advantageously incorporate the efforts of combat engineers in order to increase the division's overall combat power, a shortcoming which was further aggravated by the disproportion of combat engineer assets, in both personnel and equipment, to the normal demands of

mechanized warfare.

Although the Italian army had developed combined-arms mechanized/motorized forces, lack of time and resources prevented the refinement and improvement of these armored divisions as an offensive capability. Despite the fact that the Italian military doctrine stressed the primacy of the offensive, the Italian war-machine was not modernized to the point at which it could have accomplished this in mechanized warfare. Neither the industrial nor the technological processes could maintain a pace which would have kept the army equipped and armed for the demands of modern warfare. Thus, by June 1940, when she entered World War II, Italy had reached an impasse in mechanized warfare development; even though doctrinally she followed the blitzkrieg tradition, her physical plant did not. This problem, however, was not shared by Italy's ally, Germany.

German Mechanization and the Development of Blitzkrieg Warfare

As was the case in Italy, historic and geopolitical factors did much to shape the strategic rationale in Germany. For centuries, Central Europe had been the battleground for disputes between powerful bordering states, in rivalry to gain absolute control. Unfortunately, this region offered few natural obstacles against such invasions and, as a result, preparation for military defence evolved as a primary consideration in the politics of Germanic states, and fostered militarism within these societies.³⁷ With the unification of Germany under Prussia in 1870, the conditions inducing this psychomilieu did not change.

The new German empire was still surrounded by powerful adversaries and, in the event of war, always faced with the possibility of a two or even three front war. The only means of victory lay in an aggressive offensive campaign, aimed at quickly eliminating the opposing nation on one front before switching the entire military effort to contend with the second front.³⁸ Of primary importance, however, was that Germany could only afford to wage a war of short duration, since she lacked the resources to fight a conflict of attrition. These conditions, together with the Nazi attempts to promote German military prowess, did more than anything else to accomodate and encourage the development of the Blitzkrieg and armored warfare, methods which were formulated through the amalgamation of three basic features.

During the 1860's, the Prussian General Staff, under the guidance of General Helmut Graf von Moltke, had perfected the planning of the Kesselschlacht* (Encirclement Battle) as a means to achieve a quick, decisive victory; it was to be the first element in the Blitzkrieg formula. This new concept was based on the realization that improvements in weaponry had given the defender the advantage in combat, that the Napoleonic tactics of offensive concentration of fire and shock were no longer effective. Instead, Moltke's "Regulations for the Higher Troop Commanders" stressed a strategy in line with Liddell Hart's "baited gambit", where, before the enemy could mobilize, fast strategic maneuver (primarily dependent on the use of railroads) was executed to gain key tactical terrain which offered an

*"Kessel" means caldron or kettle, in a military context it is a pocket; "Schlacht" is a battle.

advantage to the defence while enveloping the enemy to fix him in place and to entice him into attacking a strong Prussian position frontally. By exploiting the advantages of the tactical defensive, the Prussian forces could wear down the combat effectiveness of the enemy before counter-attacking to destroy him.³⁹ This strategy was successfully used against France in 1870 and brought about Napoleon III's defeat in the Battle of Sedan. This type of campaign could be used to win a two-front war, if the ability for rapid maneuver existed. However, the improvement of European armies and frontier defences in the late 19th century made a repeat of a decisive German strategic stroke increasingly more difficult.

This was realized when the German army, in attempting a Super-Kesselschlacht, failed to execute the Schlieffenplan in 1914 due to the lack of a means for dynamic maneuver. As a consequence, the war evolved into a two-front conflict of attrition, which the Germans could not win. Nevertheless, the war gave rise to another innovation, the second element in the Blitzkrieg formula, which somewhat revitalized mobility on the battlefield. Although the Germans had done very little with tanks, they did devise new organizations, assault (Stoss) divisions, as a means to break the deadlock of French warfare.⁴⁰

These formations consisted of Sturmtruppen, specially trained infantry and combat engineers with machine-guns and light mortars, together with flamethrowers, which were employed to infiltrate the enemy's defences by by-passing strong-points to be dealt with by the following main assault units, and to attack

artillery positions which, if overwhelmed, prevented the enemy's withdrawal to new defences.⁴¹ In many situations, light artillery guns were man-handled with the advance of the Stoss formations and, together with aircraft, provided direct fire support. It was the first case of combined-arms operations, and these mixed teams or battle groups were successfully used on all fronts, as demonstrated by the noteworthy German victory over the Italians at Caporetto in November 1917, where Captain (later Field Marshal) Erwin Rommel's command captured 9,000 prisoners and 81 guns.⁴²

The Sturmtruppen could have been easily developed into even more dynamic striking forces by incorporating tanks or armored cars. However, the Armistice negated any prospect of such elaboration. The facts that the Treaty of Versailles prohibited tanks to Germany and that many high ranking officers falsely attributed defeat in the War to these vehicles sparked a great interest in armored vehicles in general. The military leadership soon began to believe that the Allies had denied Germany possessing tanks because they were the key to success on the battlefield. Accordingly, initially the German army was forced to think only in terms of anti-tank, which, by the 1930's, had fostered the development of the most formidable anti-tank units in Europe. All that was necessary then was the addition of well-equipped and well-trained armored units, the third element to complete the Blitzkrieg formula; and this the Germans had done with alarming efficiency, by the end of the 1930's.

The origins of mechanized warfare development in Germany can be found in the influence of General Hans von Seeckt who had been

given the task of organizing the post-war 100,000-man Reichsheer. Under his leadership, detailed studies were accomplished to determine the reasons for Germany's failure in the 1914 offensive, all of which showed that, if the Moltke/Schlieffen doctrine was to be successful in modern warfare, speed and maneuver had to be revitalized.⁴³ Thus, von Seeckt placed full emphasis on improving the mobility of the German army, primarily through the development of motorized infantry and the motorization of the logistical system. He also advocated a professional regular army with a greater degree of independence from civilian reserves, which could rapidly be activated and committed to combat before the enemy could mobilize his own combat potential effectively. Civilian reserve units were to be called up after hostilities had commenced and would function as home defence forces or as reinforcements of the army already in the field.⁴⁴

It was also during von Seeckt's tenure that programs of study were initiated in the army service schools, to familiarize the officer and non-commissioned officer corps with the new combined-arms concepts and the spirit of the Stoss formation, a measure which powerfully influenced the rationale of army leaders after the German rearmament began in 1934, when the concept of combat teams and methods similar to those of the Sturmtruppen

*In his Truppenfuehrung -- 1933 (Troop Command), an official statement of army doctrine, General Ludwig Beck, Chief of the Truppenamt beginning in 1933, and then Chief of the Army General Staff during the German military expansion (1935-1938), sanctioned battalion-size Kampfgruppen (Combat Teams) for use by the conventional arms (infantry, artillery) as a general rule.⁴⁵ became doctrine throughout the armed forces.

When Germany entered World War II, the greater part of the military leadership had been indoctrinated with these techniques, which demanded of them a certain independence of mind, vitalized through a combination of energy, initiative, and opportunism, guided by caution and audacity, and which was logically disciplined for flexibility in the processes of decision-making. With the incorporation of the radio, even the smallest combat group had been emancipated entirely from the constraints of static command and control. This independence of action allowed for complete responsiveness to the combat situation at the lowest levels of command and for leaders to adopt plans of operation involving any number of these autonomous combat groups, minute by minute, as circumstances presented themselves. When considering the development of the Panzer division and Blitzkrieg operations in general, these aspects became essential.

By 1929, von Seeckt's motorization program was rigging small cars to represent tanks during official exercises, while unofficially conducting experiments with tanks at Kazan testing grounds on the Volga, through a secret agreement with Soviet Russia. Small tank design cells, formed in the early 1920's within the German industrial complex, had progressively developed armored vehicle designs and programs for their production, including systems improvements in optics, armament, armor protection, engines, transmissions, suspensions, and tracks. Together with the input gain from the Kazan testing, a perfection of blueprints had been realized by 1930.⁴⁶

In the same year, Major Hans Guderian was given command of

the all-important motorized trial unit, the 3rd (Prussian) Motor Transport Battalion. By this time, Guderian had hit upon the general formula for mechanized warfare by combining the Kesselschlacht with the combat-group concept of the Stoss formation, and then supplementing these with the theories of both Fuller and Liddell Hart and, in this way, had created the Blitzkrieg.⁴⁷ He envisioned the use of a divisional armored/motorized team, comprized of combat components from all branches to achieve break-throughs and then exploit these breaches by conducting deep strategic penetrations, unhindered by the logistic limitations of the past. All constituent elements would be equipped to maintain the same speed and cross-country performance as the tanks, so as not to serve as an impediment to the overall mobility and the versatility of the formation. These penetrations would be the enveloping features of the Kesselschlacht.

As fate determined, Guderian was in the right place at the right time to develop his concepts into reality, eventually. His motorized battalion consisted of a company of dummy tanks, an anti-tank company with wooden cannons, and two reconnaissance companies, one mounted in armored cars and the other on motorcycles. This unit lacked the combat engineer and field artillery elements, and the wireless communication equipment to make it a viable combined-arms team.⁴⁸ Nevertheless, this dubiously equipped trial unit practiced every type of combat operation -- attack, defence, withdrawal, flank attack, direct attack with infantry, and cavalry co-operation with artillery and aircraft. By 1931, through the various exercises, a catalog of

essential requirements was compiled, which intended to the independent Panzerwaffe (Armored Command) of Guderian's aspirations possible. The advocates of a separate armored force now faced the resistance of the established branches, which feared the prospect of having their traditional roles in combat operations modified to allow for the emergence of what they generally viewed as a more or less upstart motorized transportation and supply service, an organization which promoted methods inconsistent with existing strategy and tactics.⁴⁹ Throughout 1932 and '33, the new motorized forces were still envisioned as filling a reconnaissance role. Further German armored development only waited for support from the government and Guderian's superiors.

The appointment of Hitler as Chancellor in 1933 marked the beginning of the end for old military elitist domination within the armed forces. By 1934, Hitler had gained complete control of the Nazi party, had assumed dictatorial power of the government on the death of President Hindenburg, and the Nazification of the army was well underway.⁵⁰ As a result of the efforts of Defence Minister General von Blomberg, a Nazi sympathizer, the armed forces were rapidly brought under the control of the Fuehrer through such methods as requiring to wear Nazi badges on all uniforms, promoting of Fascism within the military establishment, and obligating all officers and enlisted men to pledge personal allegiance to Adolf Hitler. This Hitlerization of the German armed forces was completed by the end of 1937, when the Blomberg military regime was forced to resign and the Fuehrer himself

assumed the duties of Defence Minister.⁵¹ From this point on, he was in direct command of the army.

Obviously, this process had a significant impact on the development of mechanization in the German army. Commensurate with the bellicose disposition of the Nazi rationale, designs had been completed, within months of Hitler's ascension to the chancellorship, for a new machine-gun armed light tank, the Panzerkampfwagen (Pzkw) I and, by early 1934, Lieutenant-Colonel Guderian's battalion had one platoon of these tanks for training. In February of that year, during Hitler's first visit to Kummersdorf to inspect the new equipment, Guderian was able to demonstrate to the Commander-in-Chief the basic concepts and elements of the Panzer division and to elaborate on the need for a separate Panzer Command.⁵² It was this visibility, together with support from General von Blumberg and other high ranking mechanized landpower advocates, and the fact that Guderian's concepts conformed with General von Seeckt's theories for revitalizing the Kesselschlacht that finally lead to the creation of the Panzertruppe as a distinct specialty by the summer of 1934. During four weeks of special maneuvers in August 1935 under the Panzertruppe's Chief of Staff, Colonel Guderian, further experimentation with a battalion of Pzkw I's, together with bits and pieces of other arms, clearly showed the viability of the armored combat team. At this point, Nazi megalomania, now exerting a significant influence over army policy, enabled Guderian's ideas finally to take concrete form by the end of the year. With the realization that the French army had created the first light mechanized division (division legere mecanique), the

German General Staff scrambled to assist the Panzertruppe in putting three such formations together as part of the general program to enlarge the army. Thus, the Panzerwaffe was officially established as a separate branch of service with Guderian as Commander of the 2nd Panzer division, close to its helm with the influence of a general officer.

Guderian's main concern at this point was the further development of the Panzer division along the conceptual lines of the Stoss formation, with a strategic as well as a tactical capability, while simultaneously endeavoring to incorporate this new armored formation as the offensive spearhead of the army. Even in its inception phase, Guderian's Panzer division had been tailored as a dynamically mobile combined-arms organization. It was centered on a tank brigade supported by a motorized infantry brigade, a motorized artillery regiment, a motorized combat engineer battalion, and other motorized arms and services. The division also contained an armored-car battalion and motorcycle troops to function in the reconnaissance role.⁵³ Therefore, equipment rather than organization was the vital interest at hand. The fact that Guderian, as a division commander, was somewhat removed from the hub of the process for Panzerwaffe policy-making and programming mattered very little, since his ideas on the proper equipment, organization, and training for Panzer forces had been blueprinted and only waited for his successors on the staff to implement them, but now he possessed enough authority to see his plans through to consummation. The most consequential of Guderian's schemes was the program for the development and

production of combat effective vehicles, since this represented the area of greatest deficiencies in the Panzer division of 1935, which then was equipped only with the Pzkw I machine gun carriers and trucks. As the Chief of Staff of the Panzertruppe, Guderian had intended from the very beginning of his planning to provide the greatest versatility for armored forces by advocating various tanks, all with a turret mounted cannon* for Panzer units, and cross-country vehicles, both armored and unarmored, for support elements.

Restricted by the weight limit of 24 tons, necessary to enable the combat engineers to provide rapid assault bridging, Guderian developed specifications for three types of tanks, which he considered essential for the combined-arms Panzer division:** the Pzkw II, a light tank for reconnaissance, armed with a 20mm gun, the Pzkw III, a medium battle tank for tank-versus-tank combat, armed with an accurate 50mm gun, and the Pzkw IV, a medium battle tank for the support of infantry assaults, armed with an inaccurate 75mm gun.⁵⁵ All these armored vehicles were under 19 tons in weight and could cruise at top speeds of at least 40 kmph. In addition, each tank had its own wireless communications set, commanders' tanks were equipped with two-way radios, enabling them to receive orders and pass them on

*The Krupp works had already determined the basic principle of armament and turret design for tanks by 1926; the designs of the main guns used in the 1939-41 period were perfected by 1933.⁵⁴

**As will be explained later, 24 tons was the greatest capacity assault bridging which could be developed at this time to effectively support mobile operations. The German Corps of Engineers was doing this with the introduction of the (Type B) pontoon trestle and the (Type K) box-grinder bridges in the mid-to-late 1930's.

rapidly.⁵⁶ All tanks were designed for adaptation to future demands, even though such requirements could not be ascertained in advance. Furthermore, Guderian greatly concerned himself with designs providing both comfort and convenience for the tank crews.⁵⁷ The combat stationing was arranged so that crews could cooperate effectively when in combat; an elaborate torsion bar suspension system provided for comfort and, more importantly, for improved performance in rapid cross-country, rough terrain travel.

Many of the features of the tank design also were fashioned into the plans for cross-country vehicles, especially in terms of suspension and communications.⁵⁸ To meet the stipulations of the combined-arms mission, a family of armored wheeled vehicles, Panzerspahwagen (Pzsw), and one of half-tracked transport, Zugkraftwagen (Sd. Kfz), were developed, and the vehicle types altered to suit the particular needs of each service most effectively (i.e. signals, reconnaissance engineer, anti-tank, anti-aircraft, field artillery, supply, or maintenance/repair). Some types of Zugkraftwagen were adapted as armored personnel carriers by providing them with a sloped armored plate all around to deflect hits. The Zugkraftwagen and Panzerspahwagen did much to transform the fighting quality of the armored forces by transporting the infantry and support arms alongside the tanks, thus improving combined-arms operations. Another significant aspect of Panzer division vehicles was that all these vehicle families possessed interchangeable parts, making divisional repair and maintenance very easy; if necessary, cannibalization could be

reverted to in keeping vehicle fleets operational.

Throughout the period of 1934-36, while closely scrutinizing tank development in other countries, the German industrial design cells incorporated the majority of Guderian's requirements,* and finalized designs and specifications on the Panzer division vehicle fleets, with prototypes being in the final development and testing stage.⁵⁹ Unfortunately, Germany lacked the industrial capacity to equip three armored divisions, each requiring 3,000 vehicles, within such a short period of time. Furthermore, with the rapid expansion of the army, the other services were submitting demands for their share of the new vehicles. Thus, the new armored forces had to live with the prospect of operating, at least for a few more years, with the easily manufactured Pzkw I and II models and ordinary trucks.

The massive shake-out of senior officers in late 1937 and early 1938, led to Guderian's promotion to lieutenant-general and, in February 1938, to his appointment to command the world's first armored corps, which included all Panzer divisions in the German army existing at that time. Within a year, his XVI Panzer Corps participated in the Austrian Anschluss action and in the occupation of the Sudetenland. These limited operations were of primary importance, since they brought weaknesses to the surface in the supply of services and in maintenance and repair responsiveness.⁶⁰ During these road marches, the armored columns

*The only important modification to Guderian's original proposals was that radios were provided only down to the platoon leader level of command and control, that a 37mm cannon was mounted in the Pzkw III, and that the allocation of Zugkraftwagen fell below expectations.

suffered a 30 to 35 percent breakdown rate, and had to commandeer fuel trucks or refuel from road side service stations in order to maintain their advance. Based on these experiences, Guderian integrated a greater portion of supply and service elements into his divisions and improved methods for tank recovery and repair. Now, the Panzer divisions carried a large enough provision of fuel, food, and ammunition to sustain itself for five days, and with an augmentation of three fully trained mobile workshops, two equipped with 12 ton and one with 24 ton recovery/repair Zugkraftwagen, the division now was, maintenance-wise, almost completely self-sufficient. Thus, by late 1938, the new Panzer divisions had ironed out their internal flaws and further improvement could only be reached through combat experience.

By September 1939, just before the outbreak of the War, the German army had expanded its mobile forces to seven Panzer divisions, five motorized infantry divisions, and four armored cavalry "light" divisions, with the newer formations abundantly equipped with tanks, trucks, artillery, and small arms which had recently been assimilated into the Wehrmacht with the disbandment of the Austrian and Czechoslovakian armies in 1938 and 1939. All-told, the army possessed some 3,000 tanks, the majority of which were Pzkw I, II, and 38 (Czech.) light tanks, and very few armored Zugkraftwagen. However, a reinforcement of the new medium tanks, 100 Pzkw III's and 200 Pzkw IV's, arrived on the eve of World War II.⁶¹ With these additional tank formations, being patterned after those in the XVIth Panzer Corps, Germany's armored forces were ready for a trial-and-error conflict to test their innovative concepts and techniques in conjunction and

coordination with the rest of the army, the majority of which was not mechanized.* The invasion of Poland provided such an opportunity by serving as the proving-grounds for the Blitzkrieg concept.

Poland offered the perfect situation for Germany to execute the Kesselschlacht. Mobilization was based on the old Nation-in-Arms concept in the Polish army. Thus, it took two to three weeks to reach combat manning. This, together with the fact that most of the Polish assembly areas were located along the German border, invited a double envelopment, since the German army geographically outflanked these areas due to the deployment advantages in East Prussia and Czechoslovakia.⁶³ Consequently, the German plan called for bringing a regular Polish army to battle near the German frontier where the Wehrmacht could fight within easy distance of its railheads in Silesia and Pomerania. To accomplish this, most of the Panzer, motorized, and infantry divisions of the Active Army were employed to pin down the main Polish forces west of the Vistula river. The rest of the army, in conjunction with the reserve infantry divisions, could then close the trap by marching to envelop and then annihilate any encircled enemy units trying to escape.⁶⁴

The effectiveness of this strategy was far more successful than the German High Command had anticipated themselves. Within 18 days, the Kesselschlacht had destroyed the Polish army. The swiftness of this collapse could be primarily attributed to three

*When Germany invaded Poland, out of a total of 106 divisions in the German army, 90 were dependent, in varying degrees, on railroads and horse-drawn transport for strategic movement.⁶²

Panzer and three motorized infantry divisions, which eventually were moved to spearhead the enveloping pincers. Initially, the main effort was made by Guderian's old command, XVth Panzer Corps, striking northeast from Silesia towards Warsaw. At the same time, Guderian's new XIX Panzer Corps, consisting of one Panzer and two motorized infantry divisions, battled its way across the Polish corridor and then, with the attachment of another Panzer division, independently moved across East Prussia to blitz its way southeast to Brest-Litovsk. Here contact was made with XXII Panzer Corps of Army Group South, which was driving northeast from Slovakia.⁶⁵

The campaign in Poland confirmed the premise that armored formations could spearhead the breakthrough. It was no longer necessary that an old type setpiece assault create a gap for armored formations to exploit. A properly organized mechanized/motorized spearhead, operating independently and dashing forward, far in advance of the infantry formations, had returned mobility to war. More important, the armored double pincer that closed on Brest-Litovsk had demonstrated to Hitler and other senior officers the potency of the combined-arms mechanized formation and its essentiality for the successful execution of the Kesselschlacht operation for the first time.⁶⁶

The Blitzkrieg formula was now complete. The Panzer and motorized infantry divisions had been combat tested and fully indoctrinated for mechanized warfare. At the same time, the German General Staff now possessed the basic cognizance to effectively employ these innovative formations in conjunction

with conventional forces. With the reinforcement of more medium tanks, and both armored and unarmored Zugkraftwagen during the break in hostilities provided by the "Phoney War", the Panzer divisions represented the most formidable mechanized formation in the world. It was only a matter of time before instinct and the process of cogitation would lead German military planners to devise the right combination and employment of forces to defeat the Allies on the Western Front with the same methods used in Poland. This operation was bolder and grander in design and made the "sickle cut" through France the real debut of the Blitzkrieg, a performance which owed its success to the Polish rehearsal. As will be seen, this tested version of the Blitzkrieg formula optimally incorporated the combat engineer as a fundamental provider of the dynamics characteristic of rapid armored operations. He was an essential part of the combined-arms team.

Blitzkrieg Pioneers -- The Part Played by the German Divisional (Stoss) Engineers in Mechanized Warfare

The First World War left the small German engineer and pioneer corps with several lessons learned, all of which would significantly influence the development of the divisional combat engineer role in mechanized warfare. Recommendations for an effective engineer staff system at both the corps and the divisional levels, and for the introduction of assault bridging were acted upon and later incorporated as important improvements in the new 100,000-man Reichsheer. Perhaps the most eventful realization, however, was that the combat engineer could serve

the army most effectively in the direct support mode. As equal members of the Sturmtruppen or through their participation in front-line defensive operations, the engineers had reinstated themselves as glorified infantry. From this point on, the chief aim of the divisional engineer was to cooperate extemporaneously with the front-line and maneuver units through the provision of effective hasty support.⁶⁷ By pursuing this goal, the engineer became an essential part of the Blitzkrieg formula.

Due to the modest size of post-war army and its lack of offensive weapons, the German engineers concerned themselves primarily with counter-mobility and defensive capabilities throughout the 1920's. In fact, the official basis for improving blocking, delaying, and anti-tank methods was the hope that they would serve as counter-measures to the development of armored and motorized formations in other armies.⁶⁸ British experimentation with independent massed tank formations in the late 1920's and early 1930's further prompted the German pioneer corps to perfect mobile anti-tank systems. Consequently, the combat engineers, in conjunction with the other arms (primarily anti-tank artillery and infantry), exhibited the most formidable counter-mobility and anti-tank potential in Europe.

In devising techniques and measures for this purpose, the combat engineers fully realized that the most important aim behind their missions was to rob the enemy of both speed and mobility, the primary advantages of mechanized/motorized units. Initially, concepts were based on positional type obstacles such as tank ditches and iron or concrete pyramids, high enough to prevent tanks from passing over them. These were quickly

abandoned, however, in favor of systems better suited for mobile operations.⁶⁹ Since the increase of mechanized/motorized forces in other armies necessitated more rapid means for blocking, methods for creating abatis by felling trees, blasting of road craters, demolishing bridges, and constructing simple log obstructions were streamlined and standardized.

To accomplish these tasks, new equipment in the form of mechanical tools, all of which were of light weight, quick to assemble, reliable in service, and insensitive to weather, were introduced.⁷⁰ Portable motor chain-saws provided greater flexibility in abatis obstacles and anti-tank log construction, since they had their own, built-in power source and, thus, could be moved easily. Trailer-mounted, light-weight air compressors with pneumatic drives for boring, hammering, and pile driving enhanced tasks such as drilling holes for road crater (even in hard surfaced roadways), digging of hasty field fortifications, and emplacing log anti-tank obstacles. In addition, standard military demolition charges were developed⁷¹ (Ladungen or Kiloladungen) in sizes of one, two, three, or 25 kilograms, specially wrapped in waxed paper or packed in tin boxes, and made insensitive to friction, heat, and penetration by bullets or shrapnel. (In comparison, the French and British commercial gelignite was highly sensitive and liable to detonate. It also melted when exposed to the heat.⁷²) All these assets, located either in the company headquarters' power tool section or the supply section, were allocated and issued on request to the divisional engineer establishment to increase his productivity in

the support of counter-mobility.

To counter-balance the army's weakness in tanks, the German engineers improved their landmining systems and techniques, introduced in World War I. Two types of mines were utilized, the "S-mine" (S, for Shrapnel for anti-personnel, also called "silent soldier") and the "T-mine" (T, for Teller), for anti-tank purposes.⁷³ Normally, these devices were laid in a chessboard pattern in "lines", "zones", or "fields", as dictated by the situation, at a density of about three mines per square meter. Combat engineer battalions in infantry divisions carried 6,000 mines in their basic ammunition load, enough to cover a front of two kilometers at a density of 3:1.⁷⁴ Once the company survey detachment had laid out the boundaries of the areas to be mined, and marked reference points, a platoon of combat engineers could emplant or conceal up to 1,000 mines per day, with the help of battery-lighted tapes or a mine-measuring wire (Minenmess-draht).⁷⁵ Then, an accurate plan, detailing the exact location of each type of mine, was prepared and submitted through the company to higher headquarters. Due to its portability (because logistics and transport were properly managed), its overall ease of employment, and its lethality, the landmine eventually became the German combat engineer's primary means for supporting counter-mobility, anti-tank defence, and denial operations.

All of these artificial obstructions adopted by the German combat engineers shared a remarkable and equatable resemblance with those fashioned by J.F.C. Fuller for mechanized warfare. German barrier/anti-mechanized tactics likewise followed very much the designs realized by Fuller.⁷⁶ Basically, obstacles

planned for the defence, and/or especially for withdrawal operations, were characterized as either obstacles immediately in front of a line of resistance (priority I) or as those covering the gaps between such lines (priority II). Priority I system obstacles were prepared to produce their full effect before the retirement of the defending force began. In this case, minefields were emplaced, and abatis, bridges, and road craters rigged for demolition and placed under the interlocking protective fires of the weapons in the line of resistance. After the passage of the friendly rear-guard forces, these targets were executed and gaps in mined areas closed. Priority II systems were intended primarily to supplement artillery fire, and emplaced in areas where direct or indirect fire could provide little advantage. These included locations in which the enemy could gain cover and concealment, and in which soil conditions negated the lethal effects of artillery fire. Schematics for the programming of obstacles were based on providing protection against mechanized units by forcing them to shift the direction of their attack into other sectors. The momentum of the enemy's offensive could then be blunted or slowed, since the channelizing of his mobile forces ultimately placed them in areas where the defensive anti-tank and anti-personnel fires were most effective, or where, in their retarded state, enemy key combat vehicles (tanks) could be effectively engaged. Once the enemy maneuver forces were contained and weakened, the friendly maneuver forces could counter-attack to annihilate him. This is another example of the Kesselschlacht, which could be applied to any level of

tactical combat, especially once the Panzer units were integrated into the army as an offensive weapon.

The rapidity of maneuver and actions on the modern battlefield obviously made counter-mobility techniques of this kind complex and much more difficult as armies began to create massed mechanized forces. The need for the closest possible coordination and cooperation between all arms was essential, and in this aspect of mechanized warfare, the German army became, due to its combined-arms character, a master.⁷⁷ Realizing that, in actuality, the combat engineer could never be organized and equipped to conduct defensive or blocking operations independently, the German doctrine pertaining to counter-mobility, elaborated on the need of supplementation by the other arms, as early as 1937-38. Divisional mixed formations, called blocking detachments (Spertruppen), were constituted which, in addition to the central body of motorized engineers, included motor-cyclists, motorized machine-gun units, motorized anti-tank companies, and tank-reconnaissance elements. In some instances, field artillery and/or anti-aircraft artillery were also provided.⁷⁹ Since the combat engineer was the expert, leadership, in most cases, was entrusted to the senior pioneer commander from the divisional engineer battalion, who was provided with both staff and ample means of signal (preferably wireless) communications.⁷⁸ Once established, the Spertruppe generally acted as an independent organization.

Because of the enhanced mobility of mechanized/motorized forces, flanks could easily be turned unless friendly blocking systems and defending forces were employed in breadth as well as

in depth, with the best localities for obstacles in areas where motor transport could not move off the road to by-pass, and where existing terrain provided natural obstacles which only needed to be reinforced with hasty barriers to impede mechanized mobility. To surprise the enemy with these obstacles, they were erected in areas or localities which made their early detection or anticipation unlikely. The various obstructions (Sperren) were then tied together as a system by emplacing intermediary, supplemental sector type barriers which, if properly situated, forced the enemy to dismount from his vehicle to defeat the forces covering the blocking positions and to remove the obstacles. The fundamental principle in these types of counter-mobility operations rested, consequently, with the quality and quantity of the Spertruppe covering formations.

In general terms, the German concepts for covering fire over natural and man-made obstacles stressed the need for employing direct fire weapons which could effectively engage those types of forces against which they were directed (i.e. anti-tank gun covered anti-tank minefields or unfordable rivers). Furthermore, anti-personnel weapons were always required to achieve minimum protection of the obstacle against an enemy dismounted breakthrough.⁸⁰ These are a cardinal principles in light of the fact that operations which could be executed within several hours such as restoring an old bridge or constructing a new one over a small water obstacle (20-30 meters wide), clearing a small abatis of 25 trees, or clearing a 10 meter wide gap in an average minefield (25 meters in depth) could be prolonged to last days or even

weeks when under enemy fire. The German method for adding depth to the defensive or delaying mission was to establish successive belts or lines, consisting of interacting obstacles (Sperrlinien), allowing for several secondary defensive lines of resistance which could be fallen back upon, when the existing one was breached.

In order to prepare, coordinate, and manage these complex barrier plans, especially logistical matters, special engineer staffs evolved at the corps and army level of command and control.⁸¹ These engineer general staff sections, the Pionierfuehrungsstab or Pionierkommando, formed an independent division of the headquarters it served and enjoyed an equal level of jurisdiction and esteem as any other major staff section (eg. G-1, G-2, G-3, or G-4). This differed greatly from all other armies, which normally subordinated their engineer staff or liaison sections to the traditional divisions of staff, a situation which robbed the combat engineer of the needed authority to most effectively influence operations. Responsible for directing all efforts of the engineers within its command, the Pionierfuehrungsstab consisted, in most cases, of a colonel as Chief Engineer (Pionierfuehrer), one major, one lieutenant, and two lieutenants as assistants, two geologists, and twelve non-commissioned officers, draftsmen, typists, and orderlies.⁸² The engineer staff served as a focal point at the top of the command and control structure, where the operational formulation, sustention, and coordination were most effective. Thus, requirements in time, resources, and combat assets for engineer related matters could be anticipated and rapidly programmed

throughout each phase of the planning process.

The fact that all other arms suffered inconvenience or even disadvantage mattered very little in a headquarters organized to incorporate the full potential of the combat engineer to meet the demands of mechanized warfare. In this way, any type of combat engineer operation requiring a divisional corporate effort could receive the comprehensive and concerted subsidization needed. In addition, because the engineer concerns gathered so much attention at the high levels of command, familiarity with his operations spread downwards throughout the division. Since now all participants knew exactly how combined-arms battle drills were to be carried out and realized the responsibilities of each congruent arm, the combat engineer was required to organize and train units for mobile combat-team actions.

One Pionierbataillon (combat engineer battalion) was assigned to every infantry division. This engineer organization had no "non-combat specialist" engineer units such as utility works, maintenance, repair, or construction duties, but was partially motorized, and was trained primarily for hasty engineer operations.⁸³ Under the battalion headquarters was an intercommunication section and three field companies (two on foot with horsedrawn transport); these companies represented the only units which were not fully motorized in the battalion, but important company supplements such as its headquarters section and those in each of its three platoons, the power tool section, and the baggage and supply columns were. In addition, the battalion headquarters controlled a bridging column (carrying

pontoon and trestle sets with outboard motors and motor boats) and supply/stores sections. These sections carried explosives, mines, and light technical stores and tools. Enough radio equipment existed in a battalion to establish a system of wireless communications to all these subordinate elements. The divisional combat engineer's exercises and maneuvers placed a high priority on infantry training, which was organized around small schemes intended to provide junior leaders with valuable experience in independent unit leadership and, at the same time, foster a sense of teamwork between the engineers and the formations they supported. In addition, the combat engineer platoons and squads were drilled in demolitions, mine warfare, and other types of hasty obstacles characteristic of blocking operations. To support the survivability of the combat engineer in such a mode of operation, each company was provided with light and heavy machine-guns and anti-tank weapons. In general, combat engineer units were indoctrinated to move rapidly, to defend themselves, if necessary, and to break up efficiently and operate as sub-units or to reconcentrate when required, in order to create belts of hasty obstacles (in conjunction with front-line units) by using the advantage of their increased mobility to extend these belts over the widest front possible.

With the rapid expansion of the armed forces and the creation of the Panzerwaffe in the mid-1930's, the German army could, once again, seriously consider means of improving their defensive potential. Accordingly, the combat engineers were expected to serve this aggressive stratagem with new, innovative ways enhancing mobility. The slogan "Pioniere nach vorn"

(engineers to the front) became even more important. The two most significant developments during the period immediately prior to the War were the creation of the Panzerpionier (mechanized combat engineer) battalions and the improvement of techniques in the assault and reduction of both man-made and natural obstacles.

Guderian's designs for the organization and equipage of the Panzer division took the importance of the combat engineer as an essential element in the combined-arms concept well into account. The Panzerpionier battalion was established along the same lines as the infantry Pionierbataillon. However, it was fully mechanized/motorized to enable its companies to cooperate effectively with and thus improve the mobility of the maneuver units they supported. Therefore, certain platoons in the Panzerpionierbataillon were provisioned with several, specially designed 5-ton Zugkraftwagen 6, some of which were armor-protected, and Panzerkampfwagen I, which later were replaced with the Pzkw II. At the back of these tanks, a special boom was installed which, when moved into position, extended out over the front of the vehicle for use in emplacing demolition charges and removing obstacles while under light weapons fire.⁸⁴ Thus, the Panzerpionier was offered the armor protected cross-country vehicles to allow them to keep pace and maintain close cooperation with the maneuver forces they supported, under any type of condition. The wheeled transport of both the Panzer and the infantry Pionierbataillons facilitated high-speed movement outside the range of hostile infantry fire and in places where caterpillar-track vehicles were not necessary. This was

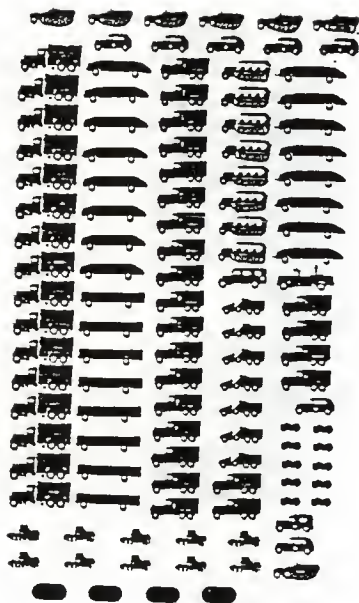


Figure 3: Panzerpionier armored and unarmored combat vehicles.⁸⁵ The equipment shown is a typical example of the combat engineer transport and fighting vehicle strength in the German army just prior to the campaign in France in 1940. The armored vehicles normally were consolidated under the specific company which moved with the advanced guard or participated in armored assaults on field fortified positions.

KEY

-  PzKw I
-  Sd Kfz 251 (armoured)
-  Sd Kfz 6
-  Engineering truck on chassis Kfz 61
-  Mercedes 130G
-  Krupp-Panzer Kfz 61
-  Ambulance 15H Kfz 31
-  Radio vehicle Kfz 17
-  Opel Blitz A-type kitchen
-  Personnel carrier Kfz 70
-  Pontoon trailer
-  Trailer
-  Inflatable boats

especially important for the support of combat engineer operations on the flanks of the Panzer penetrations and for helping to sustain the tremendous logistical requirements in engineering materials, ammunitions, and both expendable and non-expendable stores, such as barbed-wire with pickets, explosives, bangalore torpedos, landmines, replacement bridging, and sandbags, not to speak of the normal reprovisioning generated through offensive actions.

With the added potential of the Panzerpionier, the German

combat engineer ability to support mechanized warfare was complete, and especially prepared for use during an attack. In mobile operations, divisional engineer reconnaissance elements were always found with the advanced guard at the head of the attacking columns.⁸⁶ In this way, road blocks and other types of counter-mobility obstacles could be located early on and combat engineer forces called forward to clear or breach them before the main body of the division arrived. In the case where obstructions or routes of march were covered by enemy defensive fires, the divisional engineer employed Stosskampfgruppen (assault combat groups). These company- or battalion-size formations were constituted when needed through the combination of engineer, artillery, armor, anti-tank, or infantry elements and normally placed under the temporary command of the senior combat engineer. Using the combined-arms techniques, the Stosskampfgruppe assaulted those strong-points which could not be by-passed and, using mine detectors, flamethrowers, bangalore torpedos, and demolition charges, reduced, under the covering fire of accompanying weapons and/or vehicles, any static fortified positions or obstacles to allow the advance to continue.⁸⁷ In either situation, the advantage of surprise would have been lost, if the combat engineers had not been employed well forward, ready at hand to remove these types of obstacles as soon as they were met. This was especially important when water obstacles had to be bridged.

Since rivers presented the most formidable obstacle to mechanized formations, the planning and execution of operations

to cross them by assault represented by far the most complex ones. The efficiency of the German war-machine in negotiating such barriers illustrates brilliantly the fine co-ordination of arms, which characterized its tactics, and the part played by engineers in the combat team.⁸⁸ German bridging operations always proceeded at blitz tempo, starting with the arrival of the reconnaissance screen. As the advanced guard approached a water obstacle, crossing sites, affording good access and egress and a small likelihood for strong enemy resistance, were selected by the divisional engineer reconnaissance elements. At the same time, Stosskampfgruppen were constituted and assault water crossing equipment moved forward, and inconspicuously positioned close to the crossing site.

With surprise in its favor, the Stosskampfgruppe moved with Sturmbooten (storm boats) or small pneumatic rubber assault boats* to the river and crossed, under cover fire of their accompanying support weapons. Once on the far bank, the resistance of the enemy was broken by the coordinated efforts of the assaulting infantry and engineer combat teams. After a small foothold was established, improvised ferries, constructed with large pneumatic rubber boats** and local materials were started. Light artillery, anti-tank guns, armored cars, and light tanks were then crossed over to assist in widening the bridgehead and

* ** The German pneumatic boat was issued in two basic sizes: A small boat, approximately 3 meters long and 1 meter wide, with a weight of 53 kilograms and a capacity of 4 men, and a large boat, 6 meters long and 2 meters wide, with a weight of about 160 kilograms and a buoyancy of 2 tons. All divisional Pionierbataillone carried about 30 of the small boats and 20 of the large boats.

to repel any determined counter-attack.

Meanwhile, other non-divisional combat engineer units moved up to augment the crossing operation. A corps engineer battalion started to assemble float bridging*, if possible at another site several kilometers upstream, and a corps construction battalion began to rebuild demolished bridges or to construct a new fixed bridge in the near vicinity of the crossing site. Initially, pontoon and trestle rafts , assembled by the corps engineer battalion, were moved down the stream to the crossing site to carry over the medium tanks and other heavy loads of the advanced party. Then, the division engineer battalion could relinquish the on-site management of the crossing operation to the corps engineer battalion and move forward with the main body, together with its own bridging assets, and continue to support the actions of the division on the other side of the river. When enough rafts were moved to the crossing site through use of their outboard motors, they were positioned and clamped together, by couplers which engage adjacent gunwales, to form a complete floating bridge. By this time, the construction battalion had finished its task so that the main body could cross over both the floating and fixed bridges, and the division could continue the advance as a whole. Under good conditions, an entire division

*The German army bridge trains in all divisional and corps Pionierbataillonen were the same. This standard bridge company consisted of enough equipage to construct either 80 meters of a 9-ton bridge or 50 meters of an 18-ton. While the 9-ton bridge could take most loads of the infantry division, the 18-ton could accomodate the normal loads of the Panzer division. Each bridge train also possessed a powerful motor boat and several powerful (25 hp) outboard motors, and tripods, anchoring devices, and cables used in constructing a running ferry.

could be crossed within 24 hours through the use of these methods.

As the advance continued, the divisional engineers resumed their positions well forward in the columns they supported. The objective or Schwerpunkt (point of main effort) of the attack did not have to be an enemy position, but could be a direction of advance or a piece of key terrain. Whichever, the ultimate intent was to envelope the enemy. This made battledrills, as contingencies against enemy counter-attack or attempted breakthrough, essential to attacking formations, especially in armored units which spearheaded the advance. In such a situation again, the German tactics called for coordination of efforts, with the combat engineer serving a primary function. When the tank units, which normally led the formation, encountered enemy armor, they retired through an extemporaneous anti-tank screen which was, when time permitted, characteristic of counter-mobility systems. However, due to the spontaneity of these types of operations, the combat engineers usually only had time to emplace minefields or to execute bridge or road crater demolitions. Once the enemy encountered the blocking formations, the tank units maneuvered to outflank him. These tactics bear a distinct likeness to J.F.C. Fuller's idea of the "funnel formation" used, in this case, as a manifestation of the Kesselschlacht.

The operations of the combat engineers clearly illustrate how effectively the German army had incorporated the innovative concepts of mechanized warfare to revitalize their traditional grand strategy. Moreover, the high degree of coordination and

cooperation, reached between the various arms and within the Pioniertruppe (corps of engineers) itself, especially in the case of major assault water crossings, demonstrate how efficiently the Blitzkrieg formula had reintroduced dynamic mobility to the modern battlefield. The formidableness of the German mechanized forces was due neither to a greater number of tanks nor to the invincibility of its armored vehicles, but to the superior organization and methods of coordinated employment of all arms, which characterized its Panzer divisions.

An excellent example of the effectiveness of the German methods can be found in the Meuse River crossing between Dinant and Sedan, during the Blitzkrieg of France in 1940. Most military minds of that time were convinced that any armored forces would be halted for three to four days behind such a heavily defended major water obstacle, while massed infantry and artillery forced a crossing. Nevertheless, the Panzer divisions, advancing 'en masse' through this area, were able to cross at lightning speed, within 24 hours, due to the efficiency of their engineer-led combined-arms assault river crossing techniques. When one considers that the rapid crossing of the Meuse was the most critical phase of the German campaign plan, the importance of the combat engineer on the dynamic battlefield can be understood clearly.

The Axis Potential for Mechanized Warfare

As the focus of this study moves to the conflict in North Africa, it has become clear that Germany and, to a lesser degree, Italy developed their armored forces to effectively wage mechanized warfare. Their armored divisions were tailored and indoctrinated for employment as offensive strategic weapons, based on the cooperation between arms, which allowed them to conduct independent cross-country operations. To supplement the mobility of these organizations and to deter that of the enemy, the combat engineer was doctrinally prepared to function in a direct-support role and, through hasty assistance, to provide extemporaneously for the needs of all other combat arms. As will be seen, these capabilities gave the Axis armored forces the advantage on the mechanized battlefield.

FOOTNOTES

¹In the Allied camp, the tank was considered more or less a passing solution for the trench warfare problem, not a device which could be developed into a dynamic military entity. See B.H. Liddell Hart, The Tanks 1914-1939, vol. I (New York: Frederick A. Praeger Publishers, 1959), Part II "1919-1939; Adolphe Goutard, The Battle of France, 1940 (London: Frederick Muller Ltd., 1958), chapter I; and Len Deighton, Blitzkrieg (London: Jonathan Cape Ltd., 1979), Part III, "French Tanks and French Armored Divisions".

²The following publications give more detailed descriptions of the mechanization program development in the Axis nations: John J.T. Sweet, Iron Arm -- The Mechanization of Mussolini's Army 1920-1940 (Westport, Connecticut: Greenwood Press, 1980); Wilhelm Deist, The Wehrmacht and German Rearmament (London: MacMillan Press Ltd., 1981); Kenneth Macksey, Guderian -- Panzer General (London: MacDonald and Jane's, 1975), chapters 4 and 5; and Heinz Guderian, Panzer Leader (London: Michael Joseph, 1952), chapters 1 and 2.

³For an adequate understanding of the Fascist national character and the nature of Fascism in general, see: Washington Platt, National Character in Action (New Brunswick, New Jersey: Rutgers University Press, 1961); Ernst Nolte, Three Faces of Fascism, trans. Leila Vennewitz (New York: Holt, Rinehart and Winston, 1965); and Mihaly Vajda, Fascism as a Mass Movement (New York: St. Martin's Press, 1976).

⁴For more detail on Fascist Militarism, see: Paul M. Hayes, Fascism (New York: The Free Press, 1973), chapter 7, "The Influence of Militarism"; and Alfred Vagts, A History of Militarism (New York: Meridan, 1959), "Totalitarian Militarism", pp. 407-450.

⁵Although Italy normally is thought of as a non-militaristic society, actually military influence has been significant in this nation, since its inception in the 1860's. See John Whittam, The Politics of the Italian Army (London: Croom Helm Ltd., 1977).

⁶David Woodward, Armies of the World 1854-1914 (New York: G.P. Putnam's Sons, 1978), chapter 6, "Italy", pp. 90-99; and Sweet, Iron Arm, "The Elites of the Italian Army", pp. 25-27.

⁷Major-General J.F.C. Fuller, A Military History of the Western World, Vol. 3 (n.p.: Minerva Press, 1956), pp. 300-330.

⁸Sweet, Iron Arm, chapter 4, "Reggimento Carri Armati".

FOOTNOTES (Continued)

⁹General Baistrocchi, a Fascist sympathizer, as the War Undersecretary (1933-36) and the Army Chief of Staff (1934-36), encouraged Fascism in the army, promoted mechanization, and originated efforts to develop the Blitzkrieg, Italian style. It was under his leadership that the army began its transition towards mechanized warfare. See: Macgregor Knox, Mussolini Unleashed 1939-1941 (London: Cambridge University Press, 1982), "The Army's War of Rapid Decision", pp. 25-30; and Philip V. Cannistravo, Historical Dictionary of Fascist Italy (London: Greenwood Press, 1982), "Italian Army", pp. 37-40, and "Federico Baistrocchi", pp. 55-56.

¹⁰Sweet, Iron Arm, chapter 5, "From the Alps to Ethiopia".

¹¹John Coverdale, Mussolini and Franco: Italian Intervention in the Spanish Civil War (Princeton: Princeton University Press, 1974); and Sweet, Iron Arm, chapter 6, "Combat Experience".

¹²Cannistravo, Historical Dictionary of Fascist Italy, p. 39.

¹³Benedetto Pafi, Cesare Falessi, and Goffredo Fiore, Corazzati Italiani, 1934-45 (Rome: D'Anna Editore, 1968), p. 10.

¹⁴Several journal articles show the advanced state of the comprehension of mechanized warfare reached by a number of military officers by the end of 1937. For details, see: General Quarra, "In Tema di Grandi Unità Corazzate", Rivista di Fanteria, V, No. 1, (Jan. 1938):pp.1-10. This article basically advocates that the reason for the ineffectiveness of tanks in the Spanish Civil War was due to their use in small groups or independently, without the support of other arms; General Di Simone, "Convieni Trasformare la Brigata Corazzata in Divisione Corazzata", Rivista di Fanteria, V, No. 2, (Feb. 1938):pp. 79-88. General Di Simone argues for armored vehicles for the combat support troops and for greater firepower, including anti-tank weaponry and self-propelled medium artillery; and General Berardi, "Della Brigata Corazzata o Divisione che dir si Voglia", Rivista di Fanteria, V, No. 5, (May 1938):pp. 213-18. The author supports General Di Simone's call for armored vehicles for troop transport and goes so far as to suggest their use to gain the initial breakthrough and then, their use with tanks during the exploitation phase. See also, Sweet, Iron Arm, pp. 126-28, 135-38, for details on the above and the after-action report "alcune considerazioni e proposte sulla costituzione e sull'impiego della divisione corazzata", which contains recommendations from the Ministry of War on the organization and use of armored forces as a result of the 1937 maneuvers.

FOOTNOTES (Continued)

¹⁵Mussolini, as Minister of War, made mechanization an official policy, through the publication of the War Ministry's "La Dottrina Tattica nella Realizzazioni dell' Anno XVI, Circolare 9000" (The tactical doctrine in realization in the year 16 [of Fascism]) of the Stato Maggiore, on October 1938. Through this document, the high command had announced its adoption of mechanized warfare, based on principles for the strategic use of armored forces 'en masse', as army doctrine. Accordingly, the army was authorized to form a motor-mechanized corps (Armato Po) of two armored, two motorized infantry, two non-motorized infantry, and two cavalry divisions through sanction of the "Ordinamento Pariani" from the Army Chief of Staff. Sweet, Iron Arm, pp. 134-146.

¹⁶Andrew Mollo, The Armed Forces of World War II (New York: Crown Publishers Inc., 1981), p. 87.

¹⁷Commando del Corpo di Stato Maggiore, Impiego delle Unità Carriste (Rome: Istituto Poligrafico dello Stato, 1938), cited by Sweet, Iron Arm, pp. 141-42.

¹⁸Knox, Mussolini Unleashed, pp. 26-27, and "A Poor Man's War Economy", pp. 30-33.

¹⁹*Ibid.*, pp. 29-30.

²⁰Sweet, Iron Arm, "1938 Maneuvers", pp. 146-50.

²¹Brigadier-General Peter Young, and Brigadier-General James L. Collins, Jr., Eds., The Marshall Cavendish Encyclopedia of World War II, vol I (London: Orbis Publishing Limited, 1972), "The Axis Arsenal: A One-Sided Story", pp. 41-45, and "Italy: Hopelessly Unready for War", pp. 50-54.

²²Mollo, The Armed Forces of World War II, pp. 84-86.

²³Early concepts of engineer employment in mechanized warfare can clearly be seen in the following: Lieutenant-Colonel Verna, "Difesa di un Corso d'Acqua"; and Lieutenant Rosario Corso, "La Viabilita nella Guerra Motorizzata e la Relativa Attivita del Genio", Rivista di Artiglieria e Genio, (Nov.-Dec. 1935). The first article deals with the defence of a river by letting the enemy cross and then counter-attacking him with the river to his back. Emphasis is given to the fact that the friendly line of defence must have no gaps and that all obstacles must be carried by anti-personnel and anti-tank fire due to the increase of mechanization. The construction of bridges and the passage of vehicles over them must be prevented. The second article advocates that the primary interest of the combat engineer in mechanized warfare will be road maintenance and the crossing of water obstacles.

FOOTNOTES (Continued)

²⁴Paolo Caccia-Dominioni, Alamein 1933-1962--An Italian Story (London: George Allen & Unwin Ltd., 1966). Compiled from entries in the "S.O. Book 129 of 31st Battalion Combat Sappers [Italian]", pp. 28-34, and 94-99.

²⁵Sweet, Iron Arm, pp. 103 and 170.

²⁶Ibid., p. 145.

²⁷Mollo, The Armed Forces of World War II, pp. 83-88; and Caccia-Dominioni, Alamein 1933-1962--An Italian Story, pp. 109-113. When the Germans were considering crossing the Nile in 1942, they had to request a battalion of Italian pontoniers and 500 meters of bridge train, supporting the fact that bridging assets normally were held beyond the divisional level in the Italian army.

²⁸The following article clearly corroborates the advanced concepts of counter-mobility which the Italian corps of engineers was considering and developing as early as 1936. Lieutenant-Colonel Ruta, "Sbarramento d'Arresto nella Guerra di Movimento", Rivista di Artiglieria e Genio (September 1936).

²⁹The following article provides interesting details on the counter-mobility methods which were developed and practiced by the Italian combat engineers just prior to and during World War II. These techniques were supplemented later with mass landmining and anti-tank ditching to support operations in open country: Colonel Battista, "Distruzioni Impiego delle Unità del Genio", Rivista di Artiglieria e Genio (July-August 1936).

³⁰The rocky nature of most of the ground and the wide extent of the battle fronts limited the use of landmines. General Nissel, "Chars, Anti-Achars et Motorisation dans la Guerre d'Espagne", Revue Militaire Generale (December 1938).

³¹The duties of an engineer unit, employed in laying mines in a defensive position are clearly explained in this article: Lieutenant-Colonel Vanelli, "Impiego di un Reparto Artieri nel Combattimento d'Arresto durante l'Organizzazione dell'Attacco e l'Attacco", Rassegna di Cultura Militare (July-August 1938).

³²Ibid.

³³Ruta, "Sbarramento d'Arresto nella Guerra di Movimento".

³⁴The following gives an excellent description of the Italian defences around Tobruk, which had been virtually unaltered since the Italian surrender. Ian Yindrich, Fortress Tobruk (London: Ernest Benn, 1951), p. 60.

FOOTNOTES (Continued)

³⁵Caccia-Dominioni, Alamein 1933-1962--An Italian Story, p. 111.

³⁶Mollo, The Armed Forces of World War II, pp. 83-88.

³⁷For an excellent summary of the internal and external forces at work during the evolution of the German state, see A.J.P. Taylor, The Course of German History (New York: Capricorn Books, 1946).

³⁸Major-General J.F.C. Fuller, A Military History of the Western World, vol. 3, pp. 193-198.

³⁹Auszuege aus den Verordnungen fuer die hoeheren Truppenfuehrer vom 24. Juni 1869" as printed in Klassiker der Kriegskunst, edited by Werner Hahlweg (Darmstadt, 1960), cited from Major-General J.F.C. Fuller, Conduct of War, 1789-1961 (New Brunswick, New Jersey: Methuen, 1961), pp. 117-18.

⁴⁰For more detail on the new infiltration tactics developed by the Germans in the last year of World War I, see Major-General E.K.G. Sixsmith, British Generalship in the Twentieth Century (London: Arms and Armour Press, 1970), chapt. 7, "1918: The Infantry Finds its Role".

⁴¹Larry H. Addington, The Blitzkrieg Era and the German General Staff 1865-1941 (New Brunswick, New Jersey: Rutgers University Press, 1971), pp. 25-27.

⁴²For good insight into the operations of Sturmtruppen, see Erwin J.E. Rommel, Infantry Attacks (Infanterie greift an, 1937), trans. G.E. Kidde, (n.p., Washington, 1944); and Ernst Juenger, Copse 125 -- A Chronicle from Trench Warfare of 1918, trans. B. Creighton, (London: Chalto & Windus, 1930), and The Storm of Steel, trans. B. Creighton, (New York: Howard Fertig, 1975).

⁴³Edgar Roericht, Probleme der Kesselschlacht (n.p., Karlsruhe, 1958), p. XV.

⁴⁴The following is a good elaboration of von Seeckt's influence on the revision of German doctrine: Addington, The Blitzkrieg Era and the German General Staff 1865-1941, chapt. 2; see also, General [Hans] von Seeckt, Thoughts of a Soldier, trans. G. Waterhouse (n.p., London, 1930).

⁴⁵Addington, The Blitzkrieg Era and the German General Staff 1865-1941, pp. 35-38.

⁴⁶Kenneth Macksey, Guderian--Panzer General (London: MacDonald and Janis, 1975), pp. 42-43.

FOOTNOTES (Continued)

⁴⁷Heinz Guderian, Panzer Leader, trans. C. Fithgibbon (London: Michael Joseph, 1952), pp. 10 and 23-25.

⁴⁸Ibid., pp. 34-37.

⁴⁹Macksey, Guderian--Panzer General, pp. 52-63, the author gives a good explanation of the resistance within the army to the new Panzerwaffe and the political situation in Germany prior to its ascension as an official branch.

⁵⁰William L. Shirer, The Rise and Fall of the Third Reich (New York: Simon and Schuster, 1960), chapt. 7, "The Nazification of Germany: 1933-34"; and H.W. Koch, The Age of Total Warfare (New York: Frederick Fell Publishers, Inc., 1983), pp. 135-37.

⁵¹Shirer, The Rise and Fall, chapt. 10, "The Fall of Blomberg, Fritsch, Neurath and Schacht".

⁵²Although Guderian in his book Panzer Leader gives 1933 as the date of this visit, no tanks existed in Kummersdorf until 1934, as Macksey in his biography Guderian--Panzer General was able to determine, since the first tanks did not run off the assembly line until February 1934; thus, February 1934 would have to be the correct period for Hitler's inspection.

⁵³Richard M. Ogorkiewicz, Armoured Forces: A History of Armoured Forces and their Vehicles (London: Arms and Armour Press, 1970), p. 73.

⁵⁴Shirer, The Rise and Fall, p. 282.

⁵⁵Macksey, Guderian--Panzer General, pp. 64-66.

⁵⁶Ibid., pp. 66-67.

⁵⁷Len Deighton, Blitzkrieg: From the Rise of Hitler to the Fall of Dunkirk, with foreword by General W.K. Nehring [formerly Guderian's Chief of Staff] (London: Jonathan Cape, 1979), "Tank Design", pp. 150-58.

⁵⁸Chris Ellis, Military Transport of World War I Including Vintage Vehicles and Post-Second World War Models (London: Blandford Press, 1970), pp. 166-69.

⁵⁹Peter Chamberlain and Chris Ellis, Tanks of the World 1915-45 (Harrisburg, Pennsylvania: Stackpole Books, 1972), pp. 42-62.

⁶⁰Guderian, Panzer Leader, p. 56.

FOOTNOTES (Continued)

⁶¹Macksey, Guderian--Panzer General, p. 80.

⁶²Addington, The Blitzkrieg Era, "The Blitzkrieg Army", pp. 39-42.

⁶³Erich von Manstein, Lost Victories, trans. A.G. Powell (Chicago: Methuen, 1958), p. 34.

⁶⁴Roericht, Probleme der Kesselschlacht, pp. 1-3; and Major-General F.W. von Mellenthin, Panzer Battles--A Study of the Employment of Armor in the Second World War, trans. H. Betzler (Norman, Oklahoma: University of Oklahoma Press, 1983), pp. 4-5, the author states that the Polish campaign was in the tradition of the Kesselschlacht.

⁶⁵Robert M. Kennedy, The German Campaign in Poland, 1939 (Department of the Army Pamphlet 20-255), (Washington D.C.: Government Printing Office, 1956); and Manstein, Lost Victories, pp. 49-58.

⁶⁶On 9 October 1934, Hitler wrote a secret memorandum, which he personally read to the German military leaders on 10 October. Not only did he stress the importance of requiring armored formations to by-pass builtup areas, but he also encouraged his generals to concentrate weapons -- such as tanks -- in great quantities and to maintain the momentum of the attack. Here, Hitler seems to have fairly well described the features of the Blitzkrieg and to have no longer regarded the Panzer division as a propaganda device but more as a decisive weapon to achieve the crucial break-through and envelopment. See Hitler's Directive No. 6 (Nazi Conspiracy and Aggression. Part of the Nuernberg Documents, VI, pp. 880-81 -- document no. C-62), cited in Shirer, The Rise and Fall, pp. 643-47.

⁶⁷Vierteljahreshefte fuer Pioniere, "Pioniere und Infanterie im Bewegungskrieg", (Feb. 1934).

⁶⁸Deutsche Pionierzeitung, "Gedanken zur Weiterentwicklung der Pioniere", (Feb. 1936).

⁶⁹Wehr und Waffen, "Panzerabwehr", (March - August 1933).

⁷⁰Vierteljahreshefte fuer Pioniere, "Technisches Geraet zu Blockadezwecken", (Feb. 1934); and Revue du Genie Militaire, "La Motorization et la Mechanization des Unites du Genie dans l'Armee Allemande", (July- Aug. 1938). The first article provides a well written narrative of the considerations and specifications which went into the development of power tools; the second article represents an account of the actual equipment finally adapted.

FOOTNOTES (Continued)

⁷¹Wilhelm Necker, The German Army of Today (London: Lindsay Drummond Ltd., 1943), p. 63.

⁷²Charles M. Wheeler, Kalimera Kiwi: To Olympus with the New Zealand Engineers (Wellington, New Zealand: A.H. and A.W. Reed, 1946), pp. 170-171; and Brigadier-General George Clifton, The Happy Hunted (London: Cassell and Company Ltd., 1952), p. 61.

⁷³Vierteljahreshefte fuer Pioniere, "Minenlegeeinsatz", (Aug. 1940).

⁷⁴Necker, The German Army, pp. 112-113.

⁷⁵Interview in Ansbach, Germany, in 1980, with Lieutenant-Colonel Guenter Kristkeitz, a Pioneer officer in the Bundeswehr, who was a combat engineer in the Wehrmacht during World War II. See also, Major M.L. Crosthwait, "Demolitions and Minelaying -- Some German Methods", The Royal Engineer Journal, LXVI, (June 1952); and Vierteljahreshefte fuer Pioniere, "Infanterie-Pionieraktionen am Bzura", (Feb. 1940), and "Minenlegeeinsatz", (Aug. 1940). for accounts of minelaying operations during the War.

⁷⁶See the following for the general understanding of German methods in counter-mobility and defensive operations: Colonel Herman Foertsch, The Art of Modern Warfare (original title: "Kriegskunst heute und morgen"), trans. T.W. Knauth, (New York: Oskar Piest, 1940), pp. 215-16, 168-70, 184-86, and 208-09; and Colonel Dr. Karl Rossmann, Kaempfe der Pioniere (Berlin: Franz Eher, 1943), chapt. 2.

⁷⁷The following article provides an excellent example of the combined-arms counter-mobility techniques, which had been devised in the German army prior to the creation of Panzer forces. Colonel Dennerlein, "Motorisierung und Sperrungen", Vierteljahreshefte fuer Pioniere (Feb. 1936); and from the same journal, "Leichte Pionierarbeiten fuer alle Truppenzweige", (May 1936). which gives definitive information on the new pioneer field manual (HDV. 315) published in late 1935.

⁷⁸Rossmann, Kaempfe der Pioniere, chapt. 2. The author explains on several instances, how the engineers took charge in situations where obstacles had to be emplaced or removed, because they were trained for the purpose and possessed special knowledge. The other arms joined in and gave support without the least objection.

⁷⁹Major L.E. Seeman, "Barrier Tactics", The Military Engineer (May-June 1941).

FOOTNOTES (Continued)

⁸⁰Ibid.; and Captain R.A. Barron, "A Reply to Barrier Tactics", The Royal Engineer Journal, LX, (Dec. 1941). Both authors have compiled excellent summaries of the German anti-mechanized and barrier tactics developed prior to and used in the initial campaigns of World War II, through reports and accounts of observers.

⁸¹The following article provides details on the methods actually used in directing and controlling engineer operations above the divisional level. Major M.L. Crosthwait, "Demolitions and Minelaying -- Some German Methods", The Royal Engineer Journal, LXVI, (June 1952). The information is based on information provided by a former captain of the German divisional engineers, some of whose combat experience was gained with Rommel's Panzerdivision in France in 1940, and some with an infantry division on the Russian front.

⁸²Caccia-Dominioni, Alamein 1933-62--An Italian Story, p. 110.

⁸³Revue du Genie Militaire, "La Motorization et la Mechanization des Unites du Genie dans l'Armee Allemande", (July-Aug. 1938); and Captain D.E. Holbrook, "The Engineers of the German Army", The Royal Engineer Journal, LII, (Sept. 1938).

⁸⁴Department of the Army Historical Study: Small Unit Action during the German Campaign in Russia (Army Pamphlet No. 20-269), (Washington, D.C.: Government Printing Office, 1953), pp. 84-100; and Ellis, Military Transport, pp. 167-68.

⁸⁵Deighton, Blitzkrieg, endpaper chart and p. 157.

⁸⁶Militaerwochenblatt, "Pioniere und Panzerverbaende", (June 1936).

⁸⁷The following are articles on actual assault operations during the Polish and French campaigns, which provide detailed accounts of the Stosskampfgruppe in action: Vierteljahreshefte fuer Pioniere, "Einnahme von Fort IX bei Warschau", (Feb. 1940); and Militaerwissenschaftliche Rundschau, "Einnahme von Fort Bousois", (March 1941).

⁸⁸For details on the methods used by the German engineers in river crossings, see the following articles, which consist of accounts of such operations during the invasion of France in 1940. Militaerwissenschaftliche Rundschau, "Pioniere in Aktion am Oberen Rhein (Colmar)", (Jan. 1941); Militaerwochenblatt, "Divisionspioniere in Aktion", (Aug. 1940), and "Pontonarbeit an der Loire", (Sept. 1940); and Vierteljahreshefte fuer Pioniere, "Panzerpioniere durch Belgien und Frankreich", (Aug. 1940).

CHAPTER IV

THE INFLUENCE OF THE DIVISIONAL ENGINEER ON MECHANIZED WARFARE IN NORTH AFRICA FROM 1940 TO 1942 -- TRIAL BY BATTLE

The Dialectics of Armored Warfare on the Desert

The campaigns fought in North Africa were the first operations in which large-scale mechanized and motorized forces clashed. The terrific armored battles demonstrated, beyond a doubt, that well armed, mobile formations were the key to success in both offensive and defensive actions. In addition, due to the nature of this area, the characteristic methods and techniques of mechanized warfare could be employed in their purest form. There existed almost no natural obstacles to tracked vehicles and, apart from a few inhabited locations along the coast, there were neither civilian settlements nor man-made obstructions to restrict movement or the devastating activities which constituted modern warfare. As the future commander of the Axis forces in the desert, General Erwin Rommel himself testified:

North Africa may well have been the theatre in which the War was waged in its most modern guise ... It was only in the desert that the principles of armored warfare as they were taught in theory before the War could be fully applied and thoroughly developed. It was only in the desert that real tank battles were fought by large-scale formations.¹

Accordingly, the conflict, as it rolled back and forth in the Western Desert, provides the perfect setting for comparing the Allied concepts of mechanized warfare with those of the Axis. The superiority of the German methods which achieved such

decisive results in the Polish and French invasions would slowly be realized by the Allies who, as a result of the continued failure of their own procedures in each major action during the Libyan campaigns, increasingly attempted to adopt those proven by their opponents. This process of integrating new techniques into traditional methodology illustrates not only the importance of the divisional engineer on the modern battlefield but also his essential function in armored operations. By the time of the second battle of El Alamein (October-November 1942), the Allied armies had adopted the major principles of the German concepts of mechanized warfare and utilized them in their own way, with the combat engineers forsaking the rear of the battlefield to take an active and equal position alongside the other combat branches as a fundamental element in armored warfare.

In their refinement of the principles of mechanized warfare, the British lagged many years behind their opponents. Due to the fact that few British tank units participated, the 1940 campaign in France did little to change the existing perception of the organization and employment of mechanized/motorized forces. This defeat only convinced the British military leadership that more and better tanks, anti-tank guns, and motor transport were necessary to achieve victory on the battlefield. Consequently, tank units were still considered mere aids by the infantry-minded commanders, which allowed them to continue to conduct combat operations along familiar lines. The heavy infantry tanks still were to be committed to support deliberate assaults on static positions and create breaches through which the light and medium tanks passed to exploit the enemy rear and/or engage his tanks to

eliminate them. Then, the battle could be pursued as a contest between the traditional, non-mechanized formations, with the infantry as the fundamental constituent.

These subservient and estranged views for the utilization of mechanized forces fomented a pretentious reaction within the Royal Tank Corps. Almost as if suffering from a persecution complex, the armored officer developed an elitist attitude and, like the knights of old, believed that the tank alone, without the assistance of any other arm, was the decision-maker on the modern battlefield. In this way, the armored officer embraced those tasks which concentrated tanks for battle against the enemy's armor while, at the same time, disdaining any responsibility for protecting the vulnerable non-mechanized arms, as necessitated by the split-up of major formations into combat teams. This tendency was further encouraged as the Royal Tank Corps was greatly expanded just before the War through the redesignation of horse cavalry as mechanized cavalry. Through this marriage with the cavalry, the armored branch assumed the characteristics of dash, independence, and the headlong "charge", as in the old Balaclava tradition.

Thus, the corporate spirit so essential to mechanized warfare was greatly lacking in the British army of 1940, both systematically and conceptually. This limited the dynamic potential of its armored forces, since the cooperation of arms had not been realized, combined-arms tactical methods had not been developed, and, in turn, the capabilities of the supportive combat arms had never been integrated into mechanized operations,

even though they could significantly have enhanced the overall potential of the armored formation in both the offensive and defensive mode. Combined-arms operation constituted the area in which the British learned most during the campaign of the Western Desert and, as a result, the role of the divisional engineer would be altered considerably.

The First Round: The First and Second Libyan Campaigns

In September 1940, General Rodolfo Graziani advanced the Italian 23rd Corps 60 miles into Egypt and then halted at Sidi Barrani to consolidate and prepare a final thrust on the Nile. The Italian forces were sadly short of motorized transport, and the only tank formations available were those in the infantry support battalions. Unfortunately, the Italian armored divisions could not take part in this operation, due to their deployment in Northern Italy for the invasion of Yugoslavia. In truth, the invasion of Egypt was very much in the 1918 tradition. Static positions were established in the vicinity of Sidi Barrani, consisting of field fortified boxes surrounded by anti-tank ditches, minefields, and barbed wire. However, these positions were unsound with each box located out of the supporting distance of the others.² Thus, with the infantry anchored to these incompatible, static defences, without the capability for rapid movement needed to counter-attack in strength, and with the only mechanized formation fragmented in subordination to these tactics, the Italians invited defeat in detail by a mobile opponent.

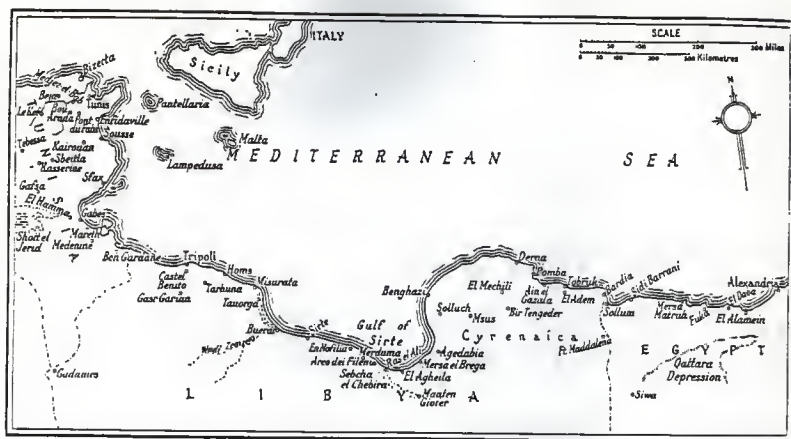


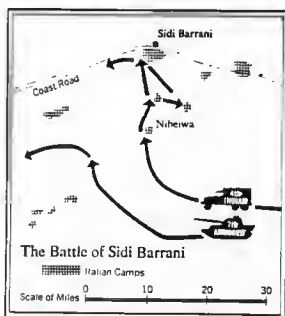
Figure 4. North-East Africa.³

Such an adversary existed in the form of the British Western Desert Force which consisted of the 7th Armored Division, a virtually all-tank organization trained by General P. Hobart at the eve of the War, the 7th Royal Tank Regiment, whose powerful Mark II infantry tanks were secretly deployed in Egypt, and the 4th Indian Infantry Division, mounted in motor transport. In December, this corps sized organization counter-attacked to seize the dispersed Italian positions in an offensive which featured few of the essential ingredients of mechanized warfare and none of the strategic paralysis concepts basic to the theories of Fuller and Liddell Hart. Actually, this succession of limited assault operations was little more than a modification of World War I tactics. The mobility of the 7th Armored Division, equipped predominantly with 1920 vintage Rolls-Royce armored cars and machine-gun-armed Mark VI Vickers light tanks, was utilized

to isolate the Sidi Barrani dispositions, while the motorized infantry together with Mark II (Matilda) infantry tanks maneuvered, under the cover of heavy artillery bombardement, to take each box position in succession by dismounted assault.⁴

Figure 5. Methods Used at the

battle of Sidi Barrani.⁵



The Italians, poorly led and trained, with no armored formation capable of decisive action, could offer almost no resistance to the entrapping actions of the 7th Armored Division nor to the massive armor of the Matildas which were proof against Italian anti-tank weapons. As a result, in the words of a British commander in the Royal Engineers present during the Sidi Barrani battle:

Here was the decisive element [the Matildas] which made success an absolute certainty; for the Italians had no guns, except possibly a few heavy anti-aircraft, able to penetrate such thick armor. Whenever the Matildas of the Seventh [Royal Tank Regiment] rolled into the enemy - that particular fight was over.⁶

If only one Italian armored division had been present in this

engagement the outcome might have been very different. With the circumstances as they were, though, the Western Desert Force could overcome one Italian garrison after another, including the major fortified points of Bardia and Tobruk, using the same methods, until Cyrenaica was almost cleared of Italian forces.

Then, by rushing a few medium tanks available across the desert south of Jebel Akhdar, O'Connor cut off most of the remains of the Italian 10th Army at Beda Fomm before they could reach the safety of Tripolitania. Here, the first tank versus tank engagement was fought, when the Italians sent forward some 70 MII/39 medium tanks in an attempt to force a passage. However, this was no contest as the superior British MK I (A9) medium tanks easily blasted the Italian armored forces to pieces. Within two months, O'Connor had advanced 500 miles, captured 130,000 prisoners, 380 tanks, 850 pieces of artillery, and 2,500 motor transport, all with a force never larger than 30,000 men.⁷ Jubilantly, the British army wore the victor's laurels and falsely believed that the successful campaign had been a brilliant application of the concepts of armored warfare, a misconception which would soon be realized.

Nevertheless, the first and second Libyan campaigns did have a significant impact on the function of Commonwealth divisional engineers, for it was during this period that their role on the battlefield began to be transformed. During the Italian drive towards the Nile, the combat engineers were primarily employed in preparing static type field fortifications in the Mersa Matruh sector. These defensive positions consisted of concrete pill

boxes, trenches, anti-tank ditches, and concrete obstacles. In addition, the divisional engineer workshops produced small quantities of anti-tank landmines, known as Egyptian Pattern (E.P.) I, which were fabricated with local materials and gelignite or TNT and used to make up for the total lack of anti-tank mines which were needed to supplement the Mersa Matruh defences and to delay the advance of the Italian divisions towards Sidi Barrani.⁸ This customary utilization of combat engineer assets could not last, however, once the British retaliatory forces encountered viable Italian counter-mobility obstacles.

As the British counter-offensive developed, the divisional engineers initially followed close behind the assaulting units. This changed, however, after the attack on Nibeiwa, the first Sidi Barrani box to be taken, where, when the tanks preceeded the infantry, five Matildas were put out of commission by landmines. As an expediant measure during the ensuing assaults, preliminary attacks by infantry assault forces with accompanying combat engineer detachments were executed in the early morning darkness to clear anti-tank mines, to blow gaps in wire entanglements, and to fill in or bridge anti-tank ditches to enable the safe passage of infantry tanks through this breach just before dawn.⁹ The mine-clearing function gained even more importance when Italian tripmines (anti-personnel) were encountered during the breaching of the Tobruk defences. Thus, the combat engineer began to be losely associated with assaults on fortified positions covered by anti-tank obstacles, since this was more or less a precautionary measure to negate the immobilization rather than the total

destruction of tanks. Although the importance of locating the combat engineers at the head of the advancing columns was further emphasized as they encountered the maze of Italian counter-mobility obstacles which blocked the routes of march through the heights of Jebel Akdhar,¹⁰ such procedures remained far from being considered a standard course of action.

The extensive use of counter-mobility obstacles during the Italian defensive and rear-guard actions prompted the British to seek methods to improve their own such capabilities. This was particularly so for anti-tank mines, which the Italians employed extensively during their retreat, especially after skirmishes between the British and German/Italian forces around El Agleila on February 26, in which the Axis forces had laid considerable minefields in front of various defensive positions, utilizing "S" anti-personnel and Teller anti-tank mines. As part of the British effort to consolidate on their recent gains, the divisional engineers relayed extensively on these experiences in preparing hasty defensive systems, the most elaborate positions being constructed along the escarpments five miles east of Barce¹¹ and several miles west of Marsa Brega. Hasty obstacles were incorporated to supplement both the possibility of withdrawal and defensive actions, including the rigging of road craters and bridges for demolition, and the emplacement of minefields. In addition, a scheme of obstacle installation was planned in the forward areas to delay the enemy.

Similarly to the new found mobility tasks of the combat engineer, these counter-mobility functions were still only

arbitrary courses of action. The most significant ramifications of this weakness would soon be felt, especially those pertaining to minefields, since no standardized system of marking, emplacing, or clearing of landmines had been developed or doctrinized yet. These engineer activities must have appeared to be more effective than they really were, however, because Rommel decided to prematurely launch his planned counter-offensive in March rather than in May to prevent the British from turning these defensive systems into a formidable offensive deterrent.¹²

The Second Round: The Third and Fourth Libyan Campaigns

Resting on its laurels, the British Western Desert Force was far less prepared to wage mechanized warfare than most believed at the time. Its most obvious debilities were recovery, repair, and maintenance, the major problem being the non-standardization of parts and fittings for the various fleets of armored vehicles, whose production was unsystematically spread over a large number of firms. During the British counter-offensive, in which only a handful of tanks were lost to enemy fire, almost the entire armored force was put out of action due to break-down, since the recovery and repair of such vehicles took weeks or even months. When Rommel struck in late March 1941, the Force was still suffering for want of vehicles. The British Force was really handicapped, however, by a much less perceptible weakness, the inability to maintain a coordinated effort between widely dispersed units on a rapidly changing battlefield. The lack of an adequate wireless communication network greatly compounded this deficiency. Against an audaciously led enemy force, equally

or better equipped with armored vehicles and weapons, and with surprise on its side, the Western Desert Force was no match, even in withdrawal operations.

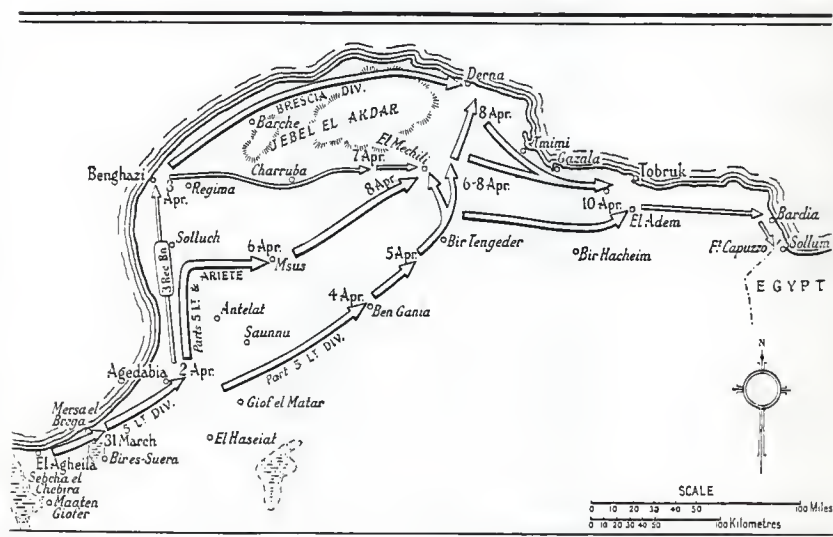


Figure 6. Rommel's First Offensive -- March 1941.¹³

Initially, Rommel intended to attack only to improve his own position and to prevent the British from establishing formidable minefields and defences, which would have inhibited his planned May offensive. With the hasty and disorganized retreat of the British forces from the Marsa Brega position, however, the Axis commander sensed the unsound condition of the Western Desert Force and decided to exploit his success with only the 5th Light

[Panzer], the Ariete Armored,* and the Bresica Infantry Divisions.¹⁵ Within 15 days, this Italo-German formation rolled rolled the Commonwealth forces all the way back to the Egyptian frontier and seized the Halfaya Pass; only Tobruk was left in Allied hands. Through a strategy of rapidly thrusting in several widely dispersed directions at the same time, Rommel gained the upper hand by throwing the British centralized command and central structure into confusion and turning their withdrawal into a rout by maintaining both an operational and a logistical intimidation over their retreat. Possessing unsuitable communications ability for fragmented operations, the Western Desert Force could at no time effect a coordinated delaying action (it tried in vain to fall back on the Barce defensive line when the Marsa Brega position had been lost) so that, due to breakdown or being outmaneuvered, its armored forces ceased to exist.

The lack of organization decisively influenced to outcome of this engagement. Since the divisional engineer organization had possessed no wireless communications of its own, it had to be split up into small units, assigned to each of the major divisional combat formations in order to provide counter-mobility support.¹⁶ This caused two difficulties. First, it scattered

*The Ariete Division had been reequipped with the new M13/40 medium tank (with a turret mounted 47mm cannon) before being shipped to Libya in late January 1941. Designed to be the main battle tank of the Italian armored division, this armored vehicle was equipped with an effective high velocity anti-tank gun and provided with thicker armor making it superior to the M11/39 which it replaced. Thus, the Italian armored units faced by the British army in 1941 were far better equipped and organized for mechanized warfare than those which fought at Beda Fomm a few months earlier.¹⁴

the combat engineer assets and placed them under the control of headquarters who, due to the lack of standard operating procedures, had little understanding of how to incorporate counter-mobility effectively into overall operations. Second, without the means of wireless communications, the divisional engineer headquarters could neither assist in improving the situation nor act as the focal point for coordination of the counter-mobility effort across the entire divisional front and thus exert the control necessary for an orderly withdrawal. Consequently, the status of the CRE was amended from that of "Commander" of Engineers to "Engineer Advisor" or staff officer, a situation which was also extended to the engineer headquarters associated with commands above division level. In the words of one corps CRE:

All these engineer units were under Divisional Control for employment, and while I could issue technical instructions direct, any personal contact had to tactfully arranged through their real masters.¹⁷

Such conditions also greatly undermined the potential of the combat engineer in the area of logistics and technical expertise. The absence of efficient and prioritized coordinating methods to provide for the prompt supply and transport of engineer materials and stores to meet the demands of mobile operations left the divisional engineers without the resources to emplace obstacle systems rapidly and viably. In addition, without the advantage of centralized control and standardized methods, the competency of lower eschalons in the divisional engineer formations suffered. During the blocking actions in both the Jebel Akhdar heights and along the avenues of approach across the desert to

its south, some obstacles were ineffective due to improper emplacement or insufficient charges, others were by-passed by the Italo-German formations because they had not been tied in with the surrounding natural or man-made obstructions.¹⁸

Without the propensity for a concerted and correlated effort, counter-mobility operations were ineffective. Only the strongly fortified Port of Tobruk, sitting on the Italo-German lines of communication with a garrison of 36,000 troops, stopped Rommel from sweeping into Egypt. Regardless of the arrival of the 15th Panzer Division on 10 April, Rommel failed in his attempt to take Tobruk by assault, primarily due to the fact that he did not possess sufficient forces to guard the Egyptian frontier and to invest Tobruk's formidable defences simultaneously (before the War, the Italians had incorporated thousands of tons of concrete and steel into these, so that they now consisted of a double row of strong points and trenches forming a 50km long semicircle around the harbor; this line was further strengthened with barbed wire, tank ditches, and minefields). In light of this situation, Rommel decided to consolidate his position and wait for further reinforcements before making another attempt to capture Tobruk. The 15th Panzer Division's Pionierbataillon was immediately given the task of constructing a defensive line along the Sollum- Halfaya axis. On the high ground around Halfaya, several deadly dual-purpose 88mm guns (Panzer/Fliegerabwehrkanonen) and a substantial number of Italian guns were dug in and camouflaged, with the anti-tank artillery being emplaced in pits so that when the barrels were elevated horizontally, they could practically not be seen. In

addition, all-round defensive positions and protective minefields were provided.¹⁹ Infantry heavy battle groups were employed in this defensive line, while the rest of the 15th Panzer Division was stationed near Bardia as a mobile reserve counter-attack force.*

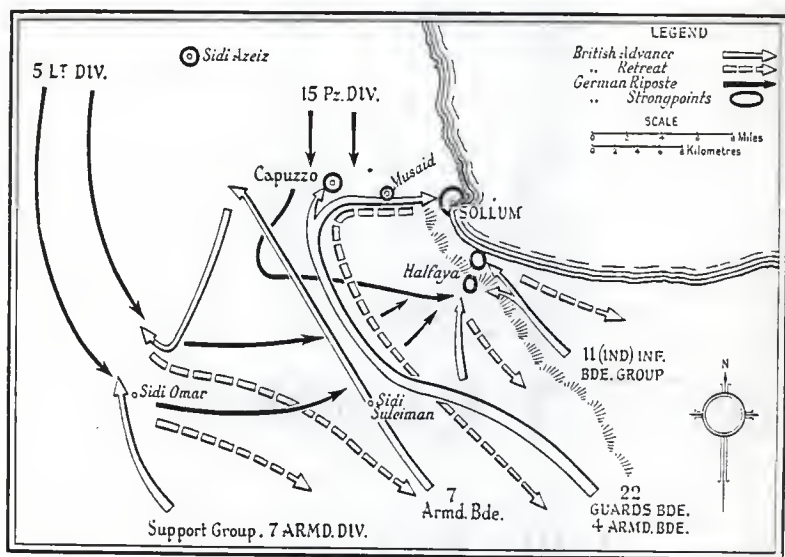


Figure 7. Operation Battleaxe -- June 1941.²⁰

In June, the British, recently reinforced with medium and heavy tanks, decided to test these defences in an effort to regain the initiative and to relieve the beleaguered garrison in Tobruk. Through "Operation Battleaxe" the Western Desert Force employed the same tactics as against the Italians less than a

*This is a clear example of Fuller's tank/anti-tank wing concept.

year before. The infantry, supported by heavy tanks, conducted a frontal assault from both the east and the west side of the German fixed defences at Sollum-Halfaya, while the 7th Armored Division and 7th Armored Brigade maneuvered around behind, engaged to destroy the enemy's armed forces, and thus isolated the positions at Sollum-Halfaya. Here for the first time, the British witnessed the offensive and defensive potential of the combined-arms team. It was also the first mechanized battle in which, at least equipment-wise, equitable armored forces clashed. Superior tactical skills on the part of the Germans caused the offensive to fall apart quickly and with heavy losses.²¹

As the 7th Armored Brigade and 7th Armored Division advanced looking for a tank versus tank encounter, the 15th Panzer and 5th Light Panzer divisions moved their mobile anti-tank elements forward to fight defensively from key terrain. These dug-in positions were spontaneously established and protected with hasty minefields. The British tank formations,* racing ahead of their supporting combat arms and attacking in true Balaclava tradition, were first mauled by the anti-tank fire of the hastily prepared positions and then smashed by the ensuing flanking counter-attacks of the German tank formations. With the British armor routed, the Panzer units proceeded to overrun the unarmored

*The British Armored Division at this time consisted of a light armored Brigade (three battalions of light and medium tanks), a heavy armored brigade (three battalions of medium tanks), and a supporting arms group (a motorized infantry battalion, a motorized artillery battalion, and an engineer squadron [company]). The Armored Brigade was organized almost exclusively on medium tank battalions. They were basically all-tank formations and incapable of combined-arms operations by themselves.

combat support and service support elements which followed up on the advance of the British tanks. This German combat drill of employing anti-tank guns to destroy the enemy's armor and then unleashing their panzers to deal with the troops and thin-skinned vehicles was used in sequence until the British armored formations were forced to retreat from exhaustion.

The infantry-based attacks on the Sollum-Halfaya defensive positions fared even worse. The prevalent 1918 idea that the tactical role of the tank was to preceed the infantry in the attack held true here also. Before the heavily armored, slow moving infantry tanks could move close enough to fire effectively with their own guns, they were engaged by the armor-piercing shells of the dug-in 88mm anti-tank guns. As they moved closer, they became immobilized in the German protective minefields within point-blank range of these deadly weapons. It was here that the assault dissipated as the Matildas were destroyed, some with their turrets completely blown off. Meanwhile, the infantry assault forces, left unprotected and without heavy support fire, were cut down and halted by the German machinegun fire. Although the combat engineers were called forward to clear withdrawal passages for the remaining tanks, few escaped destruction.²²

The losses in Battleaxe were devastating for the British. Of the 90 medium and the 100 heavy tanks, which began the battle, 29 medium and 58 heavy were lost. The Germans, practically unscathed, had only 25 tanks disabled. The necessity for more tactical cooperation between arms was sensed by the British for the first time, and, in the next six months, efforts were made

within the various formations of the Western Desert Force, to eliminate this deficiency. This was especially so in the engineer units. Besides continuing the defensive works at Marsa Matruh and initiating a new line at El Alamein, the divisional engineers developed methods which allowed them to work more closely with the attacking formations. Realizing the need for spontaneous assistance at the very head of advancing columns, they devised standard battle drills for the assault clearing of lanes through enemy protective minefields, and for laying hasty minefields of their own against enemy armor attack.²³

For clearing passages, the procedures required that the combat engineers, under covering fire, move ahead of the assault forces, blow gaps in the barbed-wire with Bangalore torpedos, and locate the mines by prodding with bayonets. Then a piece of gelignite, gripped around lines of cortex detonating fuse, was placed on top of each mine so that, once the opposite side of the mined area was reached, the clearing party could blast a lane, wide enough for the tanks to pass through. The speed of this process was enhanced for at least a few clearing parties with the introduction of field-expedient mine detectors, which were developed²⁴ and issued in limited numbers. By the end of 1941 only 13 of these very crude mine detectors were available to the entire Western Desert Force. The laying of hasty protective mines was somewhat standardized through use of a mine measuring line, which was similar in design and use to the German Minenmessdraht. This method for emplacing minefields became known as the Indian Rope Trick. To allow for its timely application in support of offensive operations, the divisional

engineer sections/troops (platoons) were issued anti-tank mines to carry with them into battle.

Once they had been propagated throughout the combat engineer organization, these measures served to place the Commonwealth divisional engineers on the front lines, where they belonged. Unfortunately, they were still handicapped by the continued use of an ineffective command and control structure, caused primarily by the lack of wireless communication, a problem further compounded, especially during offensive operations, by the lack of adequate combat transport. The field engineer companies/squadrons were basically equipped with 36 unarmored trucks, varying from 8cwt runabouts to 2-ton six-wheelers, most of which belonged to the two-wheel drive 1928 vintage (Morris-commercial D-type) or 1935 vintage (Morris 8cwt and 15cwt) fleets of vehicles, and were not very effective as cross-country transport.²⁵ In all, some 13 different types of transport existed within the typical combat engineer field unit,²⁶ causing vehicle servicing systems to be overly complex. This, together with the wear-and-tear of desert conditions, placed demands on the repair and maintenance capabilities which could hardly be met. Nevertheless, the spirit of close cooperation with the supported combat arms had finally taken hold and now only needed to be practically implemented.

While the British endeavored to ameliorate their combat readiness, the Italo-German forces made efforts to enhance their position. In order to continue his siege of Tobruk, Rommel decided to employ an improved reiteration of the methods used

against Battleaxe. The task of elaborating the Sollum-Halfaya line was assigned to the Panzergruppe Pionierkommando (engineer headquarters), by placing these positions, which were garrisoned by four battalion size combat groups, under the direct control of the Pionierkommando Chief, Colonel Hecker.²⁷ The line also was extended from the Halfaya Pass to Sidi Omar, and garrisoned by the Italian Savona Infantry Division (reinforced by German detachments with 88mm guns).

This defensive line is a perfect example of the cooperation of arms which characterized German counter-mobility methods.²⁸ Consisting of a system of independently fortified strong points, which supported each other with overlapping fires, this anti-tank shield was methodically developed. The procedures initially involved the employment of anti-tank weapons throughout the line, sited and dug in on rising ground, and infantry formations around these anti-tank defensive cores, which were situated in stone lined trenches and gun pits to provide protection against dismounted assault (in some places, captured British heavy infantry tanks were sunk in the ground with only their turrets exposed). Finally, these self-contained positions were surrounded with formidable, well-disguised minefields, which were emplaced so that they could be covered effectively by both anti-tank and anti-personnel fires. Furthermore, these mined areas were distanced far enough out to prevent enemy tank and infantry formations from moving close enough to engage the protected anti-tank gun positions effectively, and were arranged to channel enemy units trying to detour the mined areas into kill zones. In this way, the attacking formations were disrupted, slowed down,

and then blunted, and thus placed in a weakened state, giving the counter-attacking maneuver forces the advantage.

This mobile reserve for the Sollum-Halfaya-Sidi Omar positions was constituted by dispersing two armored reconnaissance battalions between Fort Capuzzo and Sidi Omar.²⁹ To prevent a British end-sweep of the defensive line, Rommel deployed the Ariete Armored Division at Bir Gubi and the 21st Panzer Division (the 5th Light Division had been redesignated) between this position and Bardia. The rest of the Axis forces were involved in the siege of Tobruk. Although Rommel possessed the equivalent of only three armored brigades, the application this Fullerite type defence prepared him to take on effectively the five brigades of armor, assembled by the British for their next offensive.

As compared to Battleaxe, operation "Crusader" was only grander in scale and complexity. Throughout the summer and fall, new tanks, trucks, and weapons flowed into Egypt and, by November 1941, the British armored brigades had been completely refitted with the latest equipment, including 336 medium tanks (mostly the new Crusader), 195 America-made M3 Stuart tanks, and 225 heavy infantry tanks. Against this formidable array, Rommel could muster 414 light and medium tanks. With its superior force, the newly constituted 8th Army intended to attack by sending its 13th Corps (4th Indian and the New Zealand infantry divisions supported by the 1st Tank Brigade) to pin down the Sollum-Halfaya-Sidi Omar line, and the 30th Corps (4th, 7th, and 22nd armored brigades supported by the 1st South African Infantry Division) to sweep around the desert flank to destroy the Axis armored forces in a

series of uncoordinated actions, the blunders of Battleaxe were repeated. In the heat of battle, the major combat arms completely disregarded the principles of combined-arms operations, which they had been haphazardly trained in, and reverted back to their old way of fighting alone. As the British phalanxes of tanks charged forward in true cavalry style and attempted to engage the German armor, they were shot to a standstill by the German tank screens (anti-tank artillery, infantry, and combat engineers) and subsequently scattered by the counter-attacking German tank units. Since the headquarters' and supporting arms' positions had not expended the effort to dig in sufficiently, they were overrun by the exploiting Panzer formations. As one German officer relates:

A good number of anti-tank guns still seemed to be unready for action. They were not dug in, but were, some of them, still on their portees [transport vehicle for anti-tank weapons].³²

The divisional engineer formations accompanying the combat support arms and headquarters, if used, could have blocked these enemy armored deluges. Unfortunately, the advantages of tactical minefields were not appreciated, in fact, they were disliked, especially by the armored officers who considered them nothing more than deadly and menacing devices which tended to clutter up the battlefield. Thus, even though the divisional engineers carried sufficient quantities of anti-tank mines to prevent the overrunning of the more static and less protected units, few combat engineer elements actually were allowed to emplace protective minefields.³³

Regardless of the fact that the combat engineers were not employed as they should have been, they provided as much as any of the other major combat arms for the destruction of enemy armored vehicles through innovation. The Crusader battles lasted for weeks and though the British could not readily recover knocked out tanks, the Axis forces were doing so and recommitted their repaired tanks at a remarkable rate. Accordingly, the Commonwealth divisional engineers were given the task of demolishing disabled tanks before the enemy could recover them.³⁴ To do this, tank destroyer parties were sent out, often in the midst of battle and, by the end of the Crusader operation, 212 Axis armored vehicles had been eliminated in this manner. In the subsequent campaigns, this became a primary function of the divisional engineer and, interestingly enough, was an important factor in the decision to equip them with armored vehicles.

The setbacks experienced in the attack of the 30th Corps were paralleled in the infantry assault on the Sollum-Halfaya-Sidi Omar line. Due to the deceptiveness of the German minefield arrangement, they could not be located most of the time until the heavy infantry tanks had already ventured onto them. By then, the combination of the Axis anti-personnel/anti-tank fires precluded the extraction of those tanks which were immobilized or the creation of gaps for following tanks to pass through. The primary problem lay in the fact that the engineers alone could not clear lanes through minefields that were covered by enemy fire and that the infantry rarely came forward to lend assistance, since they had not been indoctrinated with the

techniques to do so. Consequently, the Axis combined-arms defence remained impregnable to a succession of British assaults. As the commander of the attacking forces so aptly accounts of the attack on Sidi Omar:

Derek Gayland led the attack force [dismounted infantry and heavy tanks] at top speed to where the night's daring reconnaissance had revealed the gap but mines had been laid by the German-Italian parties working desperately through the predawn hours. In a matter of moments three carriers and four tanks [had their] tracks blown off within point blank range of hidden 88's. Now the second echelon of tanks ran into the mines ... Again [another attack] an apparent gap in the minefields was a trap, being covered by a dug-in battery of 88's. At 800 yards range they could not miss and the leading tanks erupted into horrible, flaming wrecks ... [As other tanks tried to avoid minefields] the combination of these two enemy guns to their right, and minefields to their left acted like a funnel, down which the squadrons passed on an ever decreasing front, until, when eventually a few tanks succeeded in reaching the forward enemy posts, they were almost in line ahead and broadside to the 88's. The Germans knocked out tank after tank.³⁵

The defences in fact, with the exception of those around southern Sidi Omar, overrun when an improperly mined passage was discovered³⁶, held out well past the duration of Crusader and were eliminated weeks later, when the surrounding garrison surrendered due to lack of water and ammunition.

For three weeks, the Crusader offensive flowed back and forth over the battlefield, until the 8th Army literally won through attrition, forcing Rommel's worn out, but not defeated, forces back on their defensive line at El Aghleila. During this operation the British had failed again to effectuate the principles of armored warfare and therefore were unable to destroy the Axis forces, even though the 8th Army possessed far superior

combat strength. In fact, the Army's forces were so mishandled that, by .OP the time they reached the western end of Cyrenaica, its resources were almost completely consumed. Rommel's counter-offensive in January 1942 initiated the next and final round to be fought on the Western Desert, during which the British finally developed the so-desperately-needed methods for the cooperation between arms.

The Third Round: The Fifth and Sixth Libyan Campaigns

After receiving new tanks, armored cars, and supplies, the Axis forces launched a counter-strike in late January 1942, giving the fatigued 8th Army almost no respite since the termination of its pursuit in late December. As the Italo-German forces advanced using the expanded torrent, Rommel decided to divert his main effort north-westward, towards Benghazi, rather than across the desert, towards Tobruk, as he had done in his March-1941 offensive. By thrusting through the Commonwealth weaker right flank, he caused the British to be thrown off balance turning their retreat into a repeat performance of their withdrawal in March/April 1941. With the exception of improved techniques in the employment of delaying obstacles, especially in the Jebel Akhdar heights,³⁷ Rommel moved rather rapidly until, in February, his forces were halted before the defensive line which the British had hastily prepared at Gazala. Here, both armies rested for three months, the Axis forces for further reinforcements and the 8th Army to strengthen its defences and to reequip and reorganize its formations.

The defensive line, which developed between Gazala on the

coast and Bir Hacheim, some 40 miles inland, is yet another example of the 1918 mentality, which inhibited the Allied leadership.³⁸ With the Gazala line, the British attempted to duplicate the effective defensive system developed by the Axis forces in the Sollum-Halfaya-Sidi Omar line. With their limited comprehension of combined-arms operations, however, they created little more than a miniature Maginot line, which lacked inter-cooperability and depth. In design, this line consisted of brigade-size boxes situated out of supporting distance of each other, which were surrounded by wire marked, mined belts. The spaces between these positions were filled in with "mine marshes". The employment of the mined areas as deterrents rather than, as with the Axis forces, as a channelizing weapon, constituted the primary deficiency of this arrangement.³⁹ Even worse, these mine marshes were not covered by fire. Thus, British mine warfare did not fulfil its essential function of halting tanks where they presented the best target for the anti-tank defence, since mines were not sited and concealed for this purpose. With the exception of two brigade boxes, 25 and 30 miles to the east near El Adem, the Gazala line possessed virtually no strong points to the rear and/or to the open flank, making the British still susceptible to destruction in detail. This, together with the vast uncovered distances between the self-contained, defended boxes, which could be by-passed or attacked individually, made the Gazala line vulnerable to both penetration and envelopment by a dynamically employed combined-arms mechanized opponent.

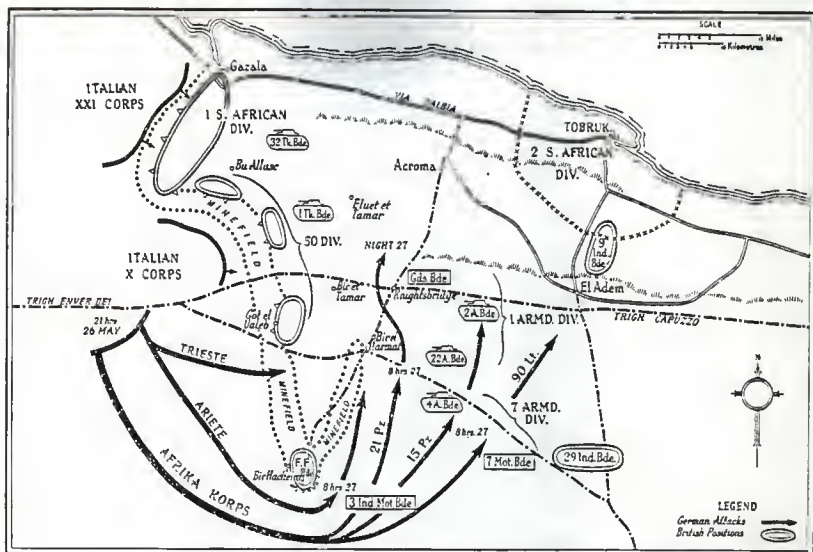


Figure 9. The Battle of Gazala, Phase 1 -- May 1942.40

The formations which manned these defences (boxes) represented the first attempt by the British to organize combined-arms combat teams.⁴¹ They were organized into infantry brigade groups consisting of three battalions of infantry, one field artillery regiment, one anti-tank and one anti-aircraft battalion, one combat engineer and one machine-gun company, and other supporting arms. Unfortunately, these units were not tactically mobile and could only be moved in relays rather than simultaneously. To defend the areas between the box positions armored brigade and motor brigade groups were intended to be formed, with the former to contain three tank regiments, one

motorized infantry battalion, and one regiment of field and anti-tank guns, and the latter of motorized infantry with a similar accompaniment of artillery. Although some progress had been made in the formation of these units, neither the armored nor the motorized infantry brigade groups were established when Rommel continued his offensive in March 1942.

Rommel's plan was based on Liddell Hart's "indirect approach".⁴² The Axis infantry was deployed to pin down the Gazala line, while the Axis armor made an end sweep around Bir Hacheim to paralyze the British command and control and service support systems, and ultimately cut off and destroy the British divisions in the Gazala positions, including the armored units behind them. As this armored battle progressed, "Battle Group Hecker" under the command of the Pionierkommando and consisting of one battalion of Italian marines with heavy support weapons, German combat engineers, and tanks, would conduct an amphibious assault between Gazala and Tobruk to help isolate the defensive line.

On 26 March, 1942, the Axis forces struck in this manner and threw their opponent, who had considered an attack on the left flank impossible, into complete confusion.⁴³ As the armored spearheads thrust forward, two infantry brigades were overwhelmed and the 7th Armored Division Headquarters captured before it could evacuate the area, making that division no longer a coherent fighting force. At this point, a major tank battle ensued and, as one German officer testifies, the tactics of the British armored formations showed little change from those used in Battleaxe and Crusader:

The Grants [M3 medium tank] and Matildas charged home recklessly -- our tanks took a severe hammering ... It is true that our anti-tank gunners exacted a heavy toll, but in some cases the British tanks forced their way up the very muzzles of guns and wiped out the crews.⁴⁴

By the 27th of May, the sheer numbers of the Commonwealth forces in guns, tanks, and men, without any definite plan or guidance, through nothing but instinctive courage, had fought the Axis columns to a standstill. If the command and control of the 8th Army had not been disrupted so much, and had been able to concentrate its armored forces, the Axis offensive could have been crushed at this point. Now, Rommel switched over to the defensive before the British could get their house in order.

The Axis armored forces moved and lodged themselves firmly within the nest of mine marches in the center of the Gazala line. Here, Rommel prepared to fight a Kesselschlacht⁴⁵, whose execution very much resembled Fuller's "funnel formation". Meanwhile, assault teams, led by the combat engineers of the Italian Trieste and Pavia infantry divisions, barely restored communications with the isolated Axis armor by cutting a series of small gaps through enemy mine marches, while under fire of the 150th Infantry Brigade Group box. Even though the British believed the breaching of the massive mine belts to be nearly impossible, especially when covered by fire, the Italians accomplished this feat within one night. This was possible only through cooperation of arms; under the covering fire of attached heavy weapons, the combat engineers had moved forward and blown gaps in the wire for the infantry element who passed through and established a bridgehead on the other side of the mine march

(there were no anti-personnel mines). Through this combination of the infantry cover fire in front and the heavy weapons behind, the Italian engineers were able to clear lanes fairly rapidly.⁴⁷ The vital supplies moving through these passages allowed Rommel to employ an anti-tank screen against the British armored formations and to concentrate his own armored divisions for the investment of the 150th Brigade box, which was accomplished by 5 June. Afterwards, while the British planned their next move in true 1918 tempo, Rommel was given four days of deparately needed respite. During this time, the Axis forces consolidated their new position by forming a bridgehead in the Gazala line, which soon came to be known as the Cauldron.

In their subsequent attack on this position, the British attempted combined-arms tactics on a large scale for the first time in the desert war. However, the operation became far too complex for forces without any experience in such methods when under fire. According to this plan, the infantry was used to drive a wedge through the enemy's anti-tank screen during the night before the armor passed through this corridor the next morning to destroy the enemy's tanks positioned in the rear.⁴⁷ In actuality, the attack turned into a disaster. In the center, the infantry could not locate the enemy anti-tank positions and, when the armor advanced to perform the planned exploitation, it ran head on into the deadly enemy 88mm screen. The armored exploitation from the north ran into the 21st Panzer Division dug in on the Sidra ridge and was cut to ribbons and forced into a minefield as it tried to retreat. As the armored formation

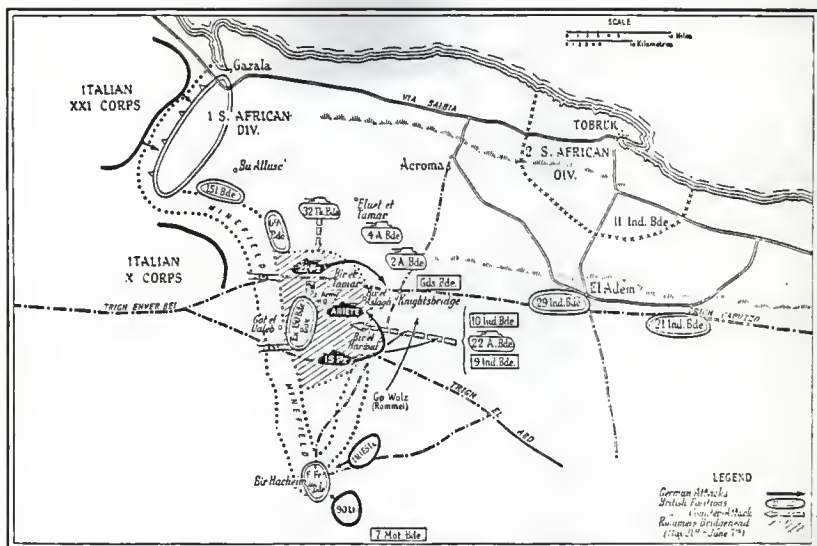


Figure 10. Battle of Gazala, Phase 2 (the Cauldron)
-- June 5-6.48

evaporated from the battlefield, the infantry was left behind to be overrun. Then, in a giant double envelopment, Rommel counter-attacked and smashed the majority of the British armored units, which were moving up to support the attack.

By a brilliant application of the funnel formation, Rommel had not only regained the initiative but had crippled the 8th Army in the process. This was followed up by another, limited victory when, between 8 and 10 June, the engineer-heavy Battle Group Hecker (Rommel had cancelled the planned amphibious assault), assisted by the 15th Panzer Division and the 90th Light

Division, succeeded in capturing Bir Hechem through the employment of battle drills similar to those used in the Italian breaching of the minefields west of the Cauldron.⁴⁹ With the exception of the remaining British armored formations assembled in the eastern vicinity of Knightsbridge, the road to Tobruk was open. On 12 and 13 June, during a meeting-engagement, this final balance of British armored potential was defeated in detail, when the Axis mechanized forces broke up its combined-arms forces. With the 8th Army in complete retreat towards Marsa Matruh, Rommel deployed his full combat power against Tobruk, which fell on 21 June.

As the victorious Axis army raced forward in headlong pursuit of the beaten, but still considerably larger, 8th Army, it tried desperately to overtake the Commonwealth forces before they had the opportunity to create another new front with fresh formations from the Egyptian hinterlands.⁵⁰ Within one week, a battle originated at Marsa Matruh, where the retreating British army despondently tried to regroup and hastily strengthen the existing defensive line in the hope of halting Rommel's lightning exploitation. The Matruh defensive line, unfortunately, suffered from the same deficiencies, which had weakened the Gazala position. Consequently, on the night of the 26th of June, instead of enveloping the line as at Gazala, the Axis forces cleared a passage through the nine-mile long mine marsh covering the gap between the two major boxes and sent all its armored formations through making the entire line untenable. Again, the remnants of the 8th Army were in full retreat

streaming back to the final defensive position in Egypt, El Alamein.

At Marsa Matruh, the speed of movement, together with surprise (the ability to penetrate the British line where least expected with massed combat power) enabled the Axis army to create disorder by paralyzing command and control, and morale of the 8th Army. In spite of Rommel's success at Marsa Matruh, the realities of geography, logistics, and relative combat strengths prohibited a repeat performance at El Alamein. Since there were only a few avenues of approach through the British line, which supported mechanized movement, the restraints of terrain forced the Axis armored thrust, for the first time, to advance along the lines of natural expectation, thus allowing the Commonwealth forces to consolidate on these points and regain their equilibrium. In such a situation, the attacker's success depended on his ability to employ an immense margin of superior combat strength, a resource which was never, throughout the conflict on the Western Desert, at Rommel's disposal. Accordingly, throughout the month of July 1942, mobile warfare gave way gradually to static operations and the initiative of the Western Desert conflict passed to the British who were now firmly based on the El Alamein line. During the next four weeks, as both armies frantically elaborated their defences and replenished their weary formations with new men, material, and equipment, the 8th Army put forth another effort to improve its tactical skills.

The methods of the German armored forces were finally realized and, to improve their battlefield performance, the British now tried in their own way to emulate them. This was

first done defensively,⁵¹ when they gave depth to the El Alamein line by establishing anti-tank defensive screens along the expected routes of enemy attack and to the rear of the main defences. These strong points consisted of dug-in artillery, anti-tank guns, and pre-excavated defilade fire points for tanks. To the front of these positions, entrenched infantry formations were located for defence against dismounted attack, and protective anti-tank minefields emplaced to deter enemy armored vehicles. In the near vicinity of these anti-tank defences, armored brigades and divisions provided mechanized counter-attacking capability. This cooperation-of-arms defence, however, unlike the German divisional system, was coordinated at the corps or army level.⁵² The conservative instincts, together with the regimental and service separatism, which had caused the brigade and divisional size combined-arms operations to break down during the fighting on the Gazala and El Alamein lines, ultimately caused the 8th Army leadership to avoid employing such principles below the corps level of command and control. In truth, the British military establishment needed many years of training and indoctrination before the existing traditional attitudes could have been moderated in favor of a combined-arms mentality at the divisional or brigade level of coordination. Nevertheless, a conversion of tactical concepts had been reached at El Alamein and improved the combat effectiveness of the British forces.

When Rommel launched one last attempt to crack the El Alamein line, August 30 - September 2, 1942, the improved methods in the employment of 8th Army forces was dearly felt by the Axis

spearheads.⁵³ As the Italo-German armored formations worked their way through the mine marshes south of Qaret el Abd during the night, they suffered heavy casualties from indirect artillery fire. The next morning, after a passage had been cleared, the armored spearheads turned north-east to move in behind the El Alamein line and, here, faced another unexpected difficulty, as Colonel Beyerlein noted: "The strength of the defences of the Alam el Halfa ridge came as a complete surprise to me. I was sure I could take it and went on attacking it much too long."⁵⁴ At the end of the first day, the Axis forces lay stalled on positions just south of the critical heights, where they regrouped to continue the attack in the early hours of 1 September. During the next day, just as the Italo-German formations moved within striking distance of the ridge, the 7th Armored Division caught the assaulting forces in the flank and pinned down the attack. The Axis armored formations had been

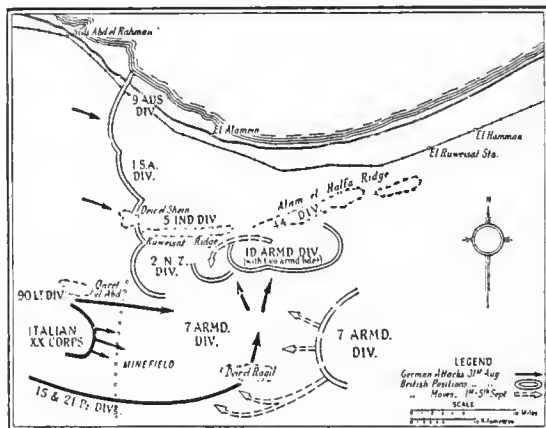
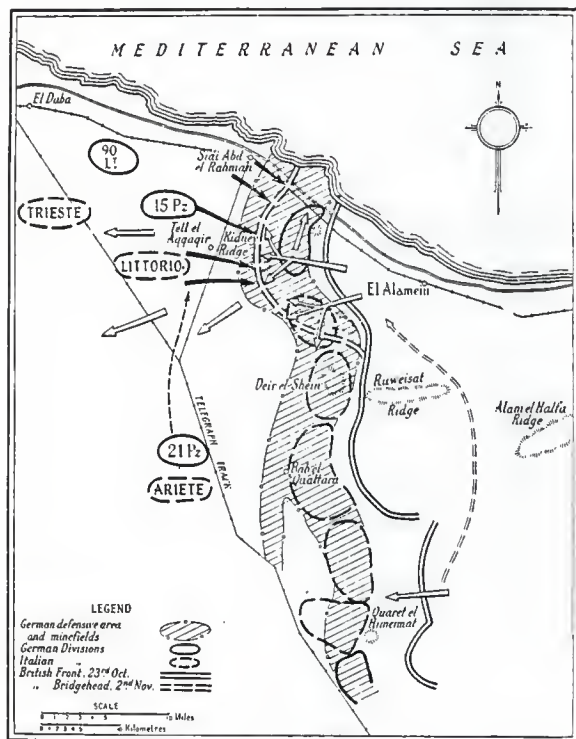


Figure 11. Battle of the Alam el Halfa Ridge.⁵⁵

beaten by their own tactics. From this point until the end of the War, the Germans and, to a lesser degree, the more static Italians steadily lost their mobility as their enemies, through emulation, increased their own.

One of the best examples of this trend was the British plan of the counter-offensive (Operation Lightfoot), to be launched two months later, with the expressed purpose of

Figure 12.
Operation
Lightfoot
Oct. 1942.56



enveloping, rather than destroying through combat, the remaining forces in Egypt. According to it, cooperation between arms again was to be executed on grand scale.⁵⁷ Divisions of infantry, supported by heavy infantry tanks and working in conjunction with their divisional engineers, first assaulted to breach the Axis minefields and defences. Then armored formations poured through this bridgehead and occupied positions deep in the left rear of the Italo-German line to dominate its supply and communication. Then, the British armor met the Axis tanks and destroyed them as they tried to brake through the encirclement. Once the Axis defences had crumbled and their armor defeated, the British mechanized forces pursued to overtake and capture the remnants of the retreating Italo-German army. In an operation which very much resembled the German Kesselschlacht, the British infantry formations were employed to assist the armored spearheads through enemy defences, whose tanks, in turn, provided an iron shield to protect the infantry. Both were working in conjunction with the aim of bringing the enemy to battle on defensible ground of their own choice, with the purpose of enveloping to annihilate. As part of this formula, the divisional engineers played an essential part.

The German obstacle system and combined-arms defence methods made mobility operations almost impossible. However, for British maneuver forces to succeed offensively, this problem had to be resolved. During the Cauldron, Marsa Matruh, and El Alamein battles, the Axis assault groups proved, to the amazement of the British, that it was feasible to make gaps through mined areas rapidly, at night and under fire. Consequently, during the

occupation of the El Alamein line, a School of Mines was established by the Royal Engineers with the purpose of determining how to breach mined areas most advantageously, of trying out new mine clearing ideas and devices, and of teaching and evolving standard drills.⁵⁸ The methods realized through the efforts of the school paralleled very much with those developed by the Axis armies.

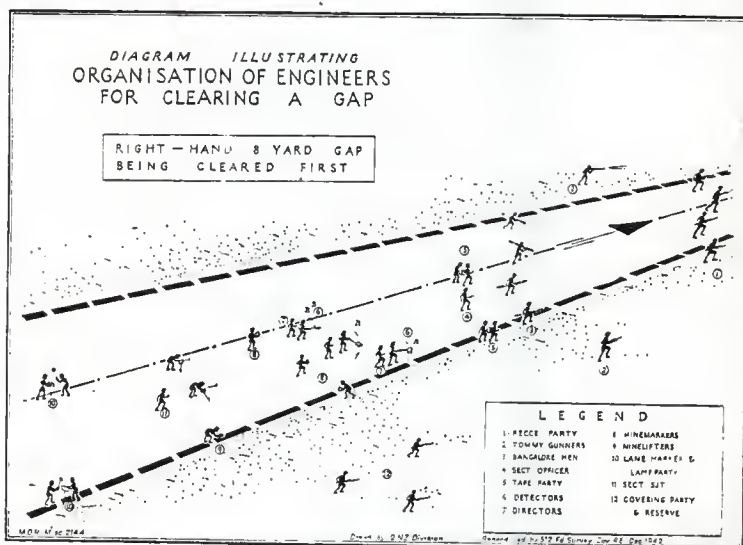


Figure 13. Standard Mine Clearing Drill.⁵⁹

Those basically were as follows. Task forces were formed, normally under the command of a divisional engineer headquarters, consisting of infantry, special mine-flailing tanks, and combat engineers. As this combat team neared the mined area, supported

by all-arms cover fire, the engineers moved forward and blew gaps in the wire, the infantry (reconnaissance party) passed into the mined area to spearhead the advance, while the engineers cleared lanes for follow-on vehicles. Finally, the combat engineers laid protective minefields for the infantry which dug in on their objectives, while the armored formations, with their own combat engineers, passed through the bridgehead to exploit the breach.⁶⁰ When necessary, infantry tanks or mine-flailing tanks were used to assist in the operation.

To enhance engineer participation in offensive operations, efforts were made to improve the survivability of the combat engineers, especially those supporting armored formations, and to establish a flexible engineer command and control. By the time of the British offensive, many of the divisional engineer field squadrons had been partially equipped with either Daimler or White armored scout cars and, shortly thereafter, the divisional field engineer companies were partially equipped with these vehicles and/or Bren armored personnel carriers.⁶¹ More importantly, wireless communication was established throughout the combat engineer organization, down to and including the platoon level.⁶² Thus, for the first time in the Western Desert conflict, the Commanders, Royal Engineers (CRE) at the corps and divisional levels could control and coordinate the engineer effort throughout their sectors of responsibility. These new capabilities provided much better efficiency and economy in the engineer effort, since the combat engineer now possessed a mobility capability equal to that of the units he supported, and the ability to manage major engineer activities in support of

widely dispersed and rapidly moving operations, which the Commonwealth forces now attempted to utilize in earnest, for the first time.

Prior to Operation Lightfoot in late October 1942, extensive training had been conducted to indoctrinate and familiarize fully 8th Army troops with the new techniques and equipment. This is not to say that the customary features of British strategy and tactics had been supplanted by the dynamic attributes of dynamic warfare. Quite to the contrary, the 8th Army principles of command and control actually used during the ensuing offensive had been altered very little. With little exception, operational planning was still characterized by calculated method and the rigid adherence to systems as well as caution and the lack of resolute decisions. As a result, the battlefield tactics were less than vigorous, forceful maneuver restrained, and success not exploited in any great depth but confined to occupation of the conquered positions.

Under the circumstances not much else could be expected. The magic of General Rommel's reputation, together with the healthy respect which the awesome German combined-arms combat potential had earned, tended to intimidate British morale. At the same time, the formidableness of the Axis field-fortified lines at El Alamein, probably the most ominous defensive system ever constructed,⁶³ could have fostered nothing but apprehension, especially when considering the fatal results of the British attack on the Sollum-Halfaya-Sidi Omar line, less than a year before.

El Alamein offered the British the opportunity to conduct an offensive along the line that they were more familiar with. More importantly, it allowed them to test extensively their first real attempt at combined-arms attack in conjunction with an offensive which guaranteed success. Where the German soldier was a combined-arms master by nature, the Commonwealth soldier still had to be convinced that he too should be one; Operation Lightfoot helped him to gain this cognizance. Seldom again would the combat arms fight according to their own rules, since, as seen in the case of the divisional engineers, only the combining of their respective capabilities on an equal basis would enable the British army to wage mechanized warfare effectively, a principle which the other Allied powers were soon to realize also.

FOOTNOTES

¹Erwin Rommel, Krieg ohne Hass (Heidenheim: Heidenheimer Zeitung, 1950), p. 118.

²See General O'Connor's memoirs from the first Wavell offensive, Brigadier-General C.N. Barclay, Against Great Odds -- The Story of the First Offensive in Libya in 1940-41 -- The First British Victory in the Second World War (London: Sifton Praed & Co. Ltd., 1955), pp. 13-20.

³Field Marshal Erwin Rommel, The Rommel Papers, Ed. by Liddell Hart, (New York:Harcourt, Brace and Co., 1953), p. 418.

⁴Ibid., pp. 30-39; and Correlli Barnett, The Desert Generals (London: William Kimber, 1960), pp. 32-37. These give excellent detail on actual employments and operations during the Sidi Barrani battle.

⁵Stephen W. Sears, Desert War in North Africa (New York: Harper & Row, 1967), p. 21.

⁶Brigadier-General George Clifton, The Happy Hunted (London: Cassell & Co. Ltd., 1952), p. 25.

⁷F.G. Jackson, The Battle of North Africa (New York: Mason, 1975), pp. 36-80.

⁸Major-General R.P. Pakenham-Walsh, History of the Corps of Royal Engineers, vol. VIII, 1938-1948 (Chatham: The Institution of Royal Engineers, 1958), pp. 231-36, and 367.

⁹Ibid., pp. 237-38; and Barclay, pp. 32-33, and 49.

¹⁰Gavin Long, To Benghazi (Canberra: Australian War Memorial, 1952), pp. 243-67.

¹¹Pakenham-Walsh, History of Royal Engineers, VIII, pp. 242-43, and 367.

¹²Field Marshal Lord Carver, The Apostles of Mobility -- The Theory and Practice of Armoured Warfare (New York: Holmes & Meier Publishers, Inc., 1979), p. 71.

¹³Rommel, The Rommel Papers, p. 108.

¹⁴John J.T. Sweet, Iron Arm -- The Mechanization of Mussolini's Army 1920-1940 (Westport, Connecticut: Greenwood Press, 1980), p. 179.

¹⁵Field Marshal Erwin Rommel, The Rommel Papers, "The Raid Through Cyrenaica", pp. 107-118.

FOOTNOTES (Continued)

¹⁶Colonel A. Crichton Mitchell, "Nobody's Sappers", The Royal Engineer Journal, LXIV (June & Sept. 1950). These articles provide an excellent narrative of the confusion and disorganization which plagued the Western Desert Force during this retreat. They particularly portray the inability of the divisional engineers to support a mobile withdrawal due to the lack of an adequate communication system, command and control structure, and doctrine.

¹⁷Clifton, The Happy Hunted, p. 117. CRE 30th Corps.

¹⁸Pakenham-Walsh, p. 246.

¹⁹Rommel, The Rommel Papers, p. 137; and Heinz Schmidt, With Rommel in the Desert (London: White Lion Publishers, 1951), p. 61.

²⁰Rommel, The Rommel Papers, p. 143.

²¹The following provide excellent accounts of the unpreparedness of the British armored formations for mechanized warfare. Major-General I.S.O. Playfair, The Mediterranean and Middle East, vol. II, (London: Her Majesty's Stationery Office, 1956), pp. 167-71; J.A.I. Agar-Hamilton, The Sidi Rezeg Battles -- 1941 (London: Oxford University Press, 1957), pp. 10-13; and Barnett, The Desert Generals, pp. 71-81, and 104.

²²Lieutenant-Colonel Edward Sandes, The Indian Engineers 1939-47 (Kirkee, India: The Institution of Military Engineers, 1956), p. 83.

²³Pakenham-Walsh, History of the Royal Engineers, VIII, pp. 339, and 343-44; Sandes, The Indian Engineers, pp. 83-84; and J.F. Cody, Official History of New Zealand in the Second World War 1939-45 -- New Zealand Engineers, Middle East (Wellington, New Zealand: War History Branch, Dept. of Internal Affairs, 1961), pp. 201-202.

²⁴These mine detectors were derivations of an American-made mineral ore locator "Goldak universal detector", used in early 1941 to locate British mines around Mersa Matruh. Clifton, The Happy Hunted, pp. 112-13.

²⁵Lieutenant-Colonel N.T. Fitzpatrick, "Mechanization and Divisional Engineers -- Part I", The Royal Engineer Journal, XLV (June 1931); Charles M. Wheeler, Kalimera Kiwi: To Olympus with the New Zealand Engineers (Wellington, New Zealand: A.H. Reed, 1946), pp. 79-80, and 103; and Chris Ellis, Military Transport of World War I including Vintage Vehicles and Post War Models (London: Blandford Press, 1970), pp. 161, and 174.

FOOTNOTES (Continued)

- ²⁶Sandes, The Indian Engineers 1939-47, p. 92.
- ²⁷Agar Hamilton, The Sidi Rezeg Battles, pp. 97-98.
- ²⁸The following give good details on the Sollum-Halfaya-Sidi Omar line. Schmidt, With Rommel in the Desert, pp. 65, 79, and 81; Agar-Hamilton, The Sidi Rezeg Battles, pp. 203-204; and Major-General Henry Maule, Spearhead General (London: Odhams Press Ltd., 1961), p. 134.
- ²⁹Schmidt, With Rommel in the Desert, p. 61.
- ³⁰Rommel, The Rommel Papers, p. 157.
- ³¹Barnett, The Desert Generals, p. 104.
- ³²Schmidt, With Rommel in the Desert, p. 110.
- ³³Cody, New Zealand Engineers, pp. 218-20.
- ³⁴Clifton, The Happy Hunted, pp. 138-39; and Pakenham-Walsh, History of the Royal Engineers, p. 347.
- ³⁵Maule, The Spearhead General, pp. 134-36.
- ³⁶Agar-Hamilton, The Sidi Rezeg Battles, pp. 203-204.
- ³⁷Sandes, The Indian Engineers, p. 88.
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FOOTNOTES (Continued)

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CHAPTER V

CONCLUSION

During the period between the end of World War I and the battle of El Alamein in October/November 1942, the influence of the divisional combat engineer on battlefield operations increased considerably. This was due, primarily, to the demands of mechanized warfare, where the importance for effective mobility and counter-mobility methods and, consequently, the necessity for the employment of combat engineers in the very thick of battle was realized on a scale which far outreached what most military leaders had anticipated. The blitzkrieg formula proved that the consolidated and strategic utilization of armored vehicles was far superior to the commonly held belief that they were best fitted to support traditional tactical methods. More importantly, as the evolution of combat engineer employment and function have illustrated, the key to the success of the dynamic thrust lay in its effective application of combined-arms techniques.

The process which ultimately resulted in the cooperation between arms as the accepted doctrine of European armies, primarily involved incorporating the capabilities of the historically uninfluential technical support arms on an equal basis with the primary combat branches. This was particularly so in the case of the combat engineer who, for centuries, had been inhibited from exercising his full support potential on the battlefield. From its very origins in the 16th century until the

beginning of the 20th century, the combat engineer as a branch of service existed as an uncongenial element in the various European military establishments, due to his technical character and the affiliation of his leadership with the bourgeoisie. Dominated by the chivalric and romantic conservatism of their aristocratic officer corps, the opposing armies during World War I continued to base their strategy and tactics on the axiom that the infantry and, to a lesser degree at this time, the cavalry, were the fundamental constituents of the military organizations. The combat engineers, together with the other technical branches, and the unique mechanical aids and capabilities which they possessed, continued to be employed in subservient roles as part of tactically estranged operations. The one exception to this general scheme was the evolution of the Stoss formation within the German army. However, the Reichsheer was unable to develop this technical innovation into a strategic potential before the 1914-18 War ended.

Despite the efforts of the military intellectuals and the adherents of mechanized landpower, who advocated the further development of the new military innovations as the basis of future warfare, the traditional attitudes prevailed in the victorious Allied nations who, seduced by the victor's syndrome and influenced by the old military elites, continued during the inter-war years to base their strategy on the features of past campaigns. The armored formations which evolved in these nations were developed by the infantry-minded military leadership as mere aids, to help them conduct combat operations along familiar lines. By ignoring the ultimate principle of mechanized warfare

theory, the cooperation of arms, new weapons and equipment were adopted without considering their possible roles in coordinated efforts of the various branches of service. Instead, new developments were sandwiched into already existing strategical and tactical doctrines, with no real thought given to the changes they might cause, if employed differently. Thus, the combat engineer developed no methods for supporting armored warfare, nor was he equipped to do so. Rather, as all other combat branches, the divisional engineers prepared to participate in combat according to their own rules.

In contrast, the totalitarian nations, Italy and Germany, through the influence of Fascism with its corporate spirit and aggressive nationalism, developed a strong affinity to mechanized warfare. With the transition for their military organizations from armies of a professional elite to that of an armed society, the way was clear for the capabilities of the technical arms to be more fully incorporated into combat operations. Consequently, both nations developed independent, combined-arms armored formations and doctrines for their strategic use in full accordance with the concepts of the mechanized landpower theorists. Although Italy, due to both the lack of time and inadequate industrial and technological processes, was prevented from developing her mechanized force into a viable offensive capability, Germany was not. Through realization of the Blitzkrieg formula, the German armed forces revolutionized warfare and, for the first time in modern history, the combat engineer functioned as an essential element in both strategical

and tactical operations.

The German Panzer division, as a highly flexible formation of all arms, depended as much on the capabilities of its engineers for its dynamics as on any other of its combat arms. More importantly, its brilliant successes on the battlefield were ascribed primarily to its systematic practice of the cooperation of arms with the divisional engineer playing a fundamental role. As the proponent for mobility and counter-mobility, the combat engineer was indoctrinated in hasty type operations and, most times, assisted by the conventional arms as well as placed over them in order to accomplish these tasks most efficiently. To allow him to carry out his mission, the combat engineer was provided with the weapons, vehicles, and equipment which gave him both survivability and mobility potentials equal to the units he supported. In addition, an effective engineer command and control structure was established to facilitate the planning and coordination of concerted efforts in engineering matters. In these ways, the German combat engineer contributed significantly to the Blitzkrieg formula and helped to reintroduce dynamic mobility to the modern battlefield.

As the conflict on the Western Desert illustrates, the superiority of the German methods in mechanized warfare completely overwhelmed the traditional procedures of the British, whose primary deficiency lay in the lack of a combined-arms effort. When with a considerable advantage in weapons, tanks, and men, the Commonwealth forces, due to their inferior organization and employment techniques, could hardly lock horns with the awesome German armored formations. Ultimately, the British had to adopt

the ways of the Axis powers in order to beat them. For the British combat engineer, this meant forsaking the rear of the battlefield and deliberate type operations to take an equal position on the front lines, and adopting hasty methods to support combat operations. It was only when the British amalgamated the capabilities of the combat engineer with those of the other combat arms that they could achieve success on the modern battlefield.

The potential of mechanized forces in modern warfare depends primarily on their ability to apply the cooperation of arms. The unique capabilities of each combat arm must be integrated to a maximum into combat operations, especially those of the divisional engineers. Any armored formation with self-imposed limitations on its mobility and counter-mobility sacrifices the dynamics on which its existence is based and is doomed to fail when faced with the demands of the modern battlefield.

BIBLIOGRAPHY

Although there are no major works which deal specifically with the influence of the divisional engineer on mechanized warfare, a number of sources provide good insight in the various aspects of this subject, as it relates to combined-arms operations. Traditionally, the combat engineers have not received the noteriety enjoyed by most of the other combat arms, which has discouraged study in this area. This situation has been further aggravated by the general unfamiliarity with military engineering technical terms and combat duties. Since a chronological approach is likely to be unsuccessful, I would recommend to read of general works and then to narrow the focus to more specific areas of interest.

As a start, two comprehensive histories of military engineering, the History of the Corps of Royal Engineers and the Geschichte des Preussischen Ingenieur-und-Pionier Korps, together with Alfred Vagt's A History of Militarism provide a critical analysis of combat engineer involvement in combat operations before mechanization. In addition, several articles in the Journal of the Royal United Services Institution (1885-1887), summarized under the title "The Engineer Arm in Continental Armies" by Captain W.A. Hare, give excellent accounts of the organization, equipment, and function of the combat engineer units prior to World War I.

Many books cover mechanization, but few deal with the role of the combat engineer or the combined-arms team. A review of the mechanized landpower theories, however, provides valuable

information pertaining to the latter two topics. Robin Higham's The Military Intellectuals in Britain 1918-1939 and Jay Luvaas's The Education of an Army -- British Military Thought 1815-1940 are basic to gain a good understanding of the development of the principal concepts of mechanized warfare. More details can be obtained from the works of the military theorists, themselves, such as B.H. Liddell Hart's Thoughts on War and The British Way in Warfare, as well as J.F.C. Fuller's Armoured Warfare and Machine Warfare.

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Critical analyses of the concepts for the employment of forces in the armored battles in North Africa are provided in Erwin Rommel's The Rommel Papers, Correlli Barnett's The Desert Generals, J.A.I. Agar-Hamilton's The Sidi Rezeg Battles, and S.O. Playfair's The Mediterranean and Middle East, vols. II and III. While these works excellently cover the inadequacies of the British army in the conduct of mechanized operations, the following official military engineering histories portray the

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THE DIVISIONAL COMBAT ENGINEERS AND THE DEVELOPMENT
OF MECHANIZED WARFARE
1918 - 1942

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For centuries, the combat engineer has, in various degrees, influenced battlefield operations. However, until the advent of mechanized warfare, this combat support arm had been inhibited from exercising its full potential in assisting armies, on both the tactical and strategical levels. From its very origins, the combat engineer arm, due to its technical character and the affiliation of its leadership with the bourgeoisie, evolved as an uncongenial element in the various European military establishments, which were dominated by the chivalric and romantic conservatism of their aristocratically based officer corps. When the nature of armed conflict transended from limited to total warfare, and technology began to play a decisive role in military actions, the influence of the combat engineer on battlefield operations started to increase. As a consequence, those military establishments which most effectively incorporated the capabilities of the combat engineer as well as the other technical arms into their military operations greatly improved their overall tactical and strategical advantage. In addition, the introduction of the tracked armored fighting vehicle to combat operations offered a weapon, which could revolutionize warfare, to those who properly developed it. How this new warmachine was militarily assimilated and employed in relation with the existing combat and combat support arms determined its effectiveness on the battlefield.

Through the review of the theories, processes, and developments, which led to the evolution of armored formations, this thesis offers an insight into the importance of mobility and counter-mobility and into the essential function played by the

combat engineer on the dynamic battlefield. Through historical developments it is illustrated how the application of the combined-arms concept, with the combat engineer as a primary member, became the key to success in the dynamic, mobile warfare which dominated the World War II campaigns in North Africa.